State of Alaska
Department of Natural Resources
Division of Oil and Gas

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Petroleum Potential of the Eastern National Petroleum Reserve-Alaska

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Purpose and Organization

This paper briefly discusses the petroleum potential of the eastern portion of the National Petroleum Reserve-Alaska (NPRA). Its primary purpose is to generate interest in renewed oil and gas leasing, exploration, and, hopefully, development within the NPRA. A secondary purpose of this paper is to illustrate, by describing the 1994 discovery of a giant oil field on state land which adjoins the NPRA, the remaining potential for undiscovered giant commercial oil fields in onshore and nearshore areas in Alaska. In doing so, this paper hopes to stimulate additional industry interest and investment in Alaska exploration. In the near future, the more technical aspects of this paper will be released as a formal Division of Geological and Geophysical Surveys (DGGS) publication

This paper is divided into six sections. The first section summarizes arguments supporting renewed leasing within the NPRA. The second section discusses the status of renewed leasing within the NPRA. The third section is largely historical in nature and reviews the exploration and leasing history in the NPRA. The fourth section introduces North Slope geology, discusses the petroleum geology of the NPRA, and reviews its known, but as yet non-commercial, oil and gas discoveries. The information in this section is primarily derived from previous publications, particularly those of the United States Geologic Survey (USGS). The fifth section presents new information on the geology and petroleum potential of the Colville River delta area (Colville delta area), which generally adjoins the northeastern edge of the NPRA. It includes a discussion of known Jurassic and Lower Cretaceous oil accumulations in the Colville delta area, including the giant Upper Jurassic Alpine oil field discovered by ARCO and partners in 1994. The sixth and final section of this paper synthesizes information from the previous two sections to discuss the overall prospectiveness of the proposed eastern NPRA lease sale planning area.

All data and interpretations presented in this paper are based on publicly available information. This information includes released well information, USGS seismic data from the NPRA, and other published or publicly available geologic, geophysical and engineering data and reports. No proprietary data is incorporated into this paper.

Summary of Arguments Supporting Renewed Leasing within the NPRA

Discovery of a new giant oil accumulation, the Alpine Field, along the Colville River adjacent to the NPRA (Figure 1), has focused national attention on the possibility of renewed leasing in the eastern NPRA. In October 1996, ARCO Alaska, Incorporated (ARCO), Anadarko Petroleum Corporation (Anadarko), and Union Texas Petroleum Alaska Corporation (UTP), announced the discovery of the Alpine Field in the western Colville delta area at a location 34 miles west of the Kuparuk River Field. ARCO states that the Alpine Field contains 800 million to one billion barrels of oil-in-place and has economically recoverable reserves of 250-300 million barrels of oil.

In addition to the discovery of this large, soon to be developed, oil field, other factors also argue for re-opening the NPRA to competitive leasing. These factors include: 1) large area with a low density of well and seismic control; 2) no leasing in the past 13 years; 3) good potential for large stratigraphic oil and gas accumulations; 4) the presence of many known non-commercial oil and gas accumulations and shows (indicating that the necessary geologic elements of trap, source, reservoir, and timing are all present); and 5) exploration, development and production technology, as well as environmental protection and monitoring, has greatly improved since the last period of NPRA exploration in the 1980's.

The NPRA is roughly the size of Indiana. Whether or not it holds commercial oil or gas deposits cannot be determined without a comprehensive, modern exploration program. Geoscientists at the Alaska Department of Natural Resources, Division of Oil and Gas, believe the NPRA has considerable oil and gas potential and offer the following observations:

1. The 23.5 million acre NPRA encompasses tremendous geologic diversity and is under-explored by modern industry standards. Yet, acreage within the NPRA has not been offered for competitive leasing since July 1984.

2. Federal government drilling programs in the NPRA spanned a period of 38 years, but failed to find commercial deposits of oil and gas (other than natural gas used for local consumption at Barrow).

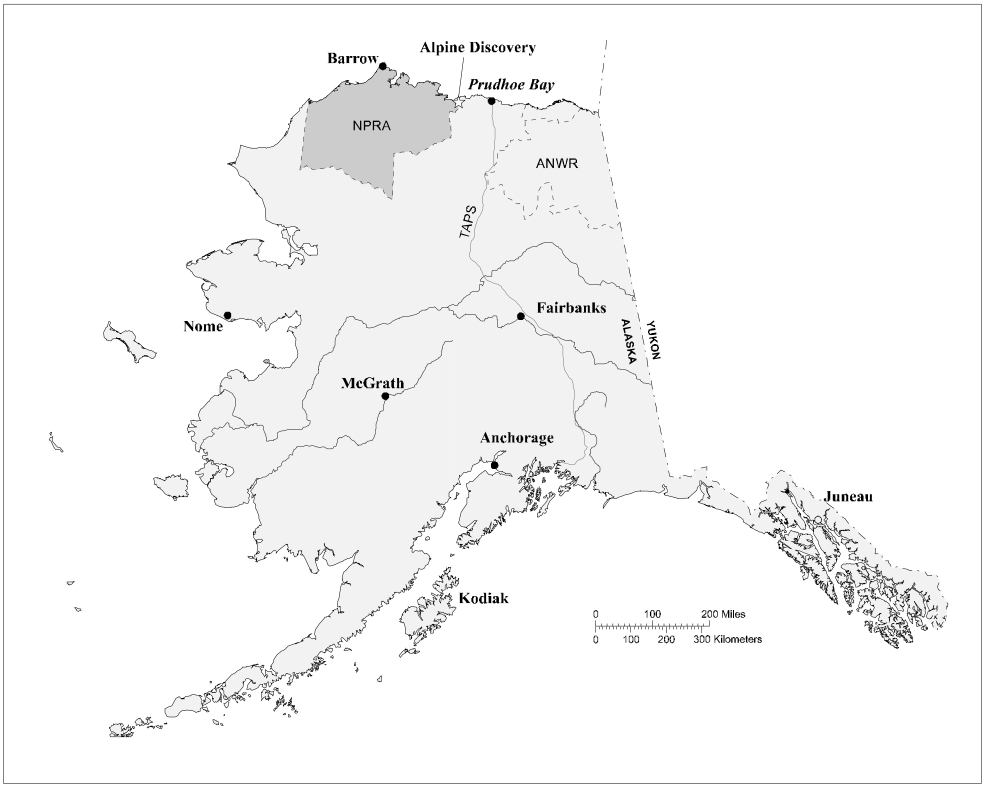


Figure 1. Location map showing the NPRA and the Alpine Field discovery. TAPS is the Trans Alaska Pipeline System which transports North Slope crude oil from Prudhoe Bay to Valdez.

Early drilling, from 1944-1953, had a stated aim of determining whether or not commercial quantities of petroleum was present within the NPRA (Reid, 1958 and Schindler, 1988). A second drilling program was conducted between 1975 and 1982. The primary objective of this program was the acquisition of geological knowledge. The discovery of oil or gas was a secondary objective (Schindler, 1982). Because this second program focused on the acquisition of geologic information and not primarily on the search for economic accumulations of hydrocarbons, it was different from one that would have been conducted by a commercial operator. Neither the first nor second phase of drilling in the NPRA could be considered a thorough prospect-level evaluation using today's industry technology.

3. The federal government held four competitive lease sales in the NPRA from January 1982 through July 1984. This accelerated leasing schedule resulted in the "rapid-fire" offering of over 8.8 million acres. Bonus bids totaled nearly $85 million. Industry acquired about 1.4 million acres. Little actual exploration work was conducted on this acreage and only one industry exploration well was ever drilled. All leases have reverted back to the federal government.

   The accelerated leasing schedule from 1982 through 1984 may have resulted in companies acquiring more land than they could realistically explore. It should also be noted that in the early 1980's oil companies were extremely busy exploring their other extensive state and federal lease holdings, particularly in areas nearer to the Prudhoe Bay Field. In addition, the oil price collapse in 1985 had an extremely negative impact on all North Slope exploration activities. As a result, a focused industry exploration effort in the NPRA never materialized.

4. Within the eastern NPRA, Jurassic and Lower Cretaceous rocks of the Beaufortian Sequence along the rift trend are the most likely reservoirs for commercial oil deposits, especially along the Barrow Arch. The Kuparuk Formation, it's equivalents and underlying sands within the Kingak Shale are the most

prospective reservoir rocks. This potential has been demonstrated by numerous oil discoveries made on state lands adjoining the eastern boundary of the NPRA, including the giant Alpine Field.

5. The application of modern exploration techniques, a better understanding of northern Alaska geology, and North Slope cost containment efforts should beneficially impact a new round of NPRA exploration. Seismic sequence analysis (sequence stratigraphy), amplitude analysis, advanced depositional models and 3-D seismic surveys should help delineate new prospects and reduce drilling risk.

   The search for large structural traps dominated North Slope exploration in the early 1980's. Explorers sought reservoirs with similar geologic characteristics (age, depositional environment, structural and stratigraphic setting, and reservoir properties) to the Prudhoe Bay Field. They thought that the minimum economic field size away from Prudhoe Bay infrastructure was one billion barrels of recoverable oil. Current plans to develop the smaller and geologically dissimilar Alpine and Badami oil fields prove that this old thinking is not valid today. Long-reach drilling, reduced pad size, elimination of reserve pits, underground injection of disposed drilling fluids, ice pads, centralized waste management and recycling, and advanced facilities design have dramatically reduced costs and helped to shrink the minimum economic field size.

6. The potential for giant gas accumulations exists throughout the NPRA, but no transportation system exists for North Slope gas despite the presence of 28 trillion cubic feet of gas at Prudhoe Bay. The fact that Prudhoe Bay's huge gas reserves remain untapped indicates that the commercial viability of North Slope gas on the worldwide market is still unknown.

7. Lack of existing oil and gas transportation infrastructure, remoteness and fragile arctic ecosystems will challenge NPRA operators. These challenges are neither unique nor insurmountable given modern drilling and development technology. Alpine Field development, 34 miles west of the Kuparuk River Field, will place development infrastructure and a pipeline at the NPRA border. Commercial oil deposits -- if discovered in the eastern half of the NPRA -- will probably be processed on site and transported by Alpine's pipeline to the Trans-Alaska Pipeline (TAPS). Alpine Field development plans suggest what future facilities and infrastructure in the NPRA might look like.

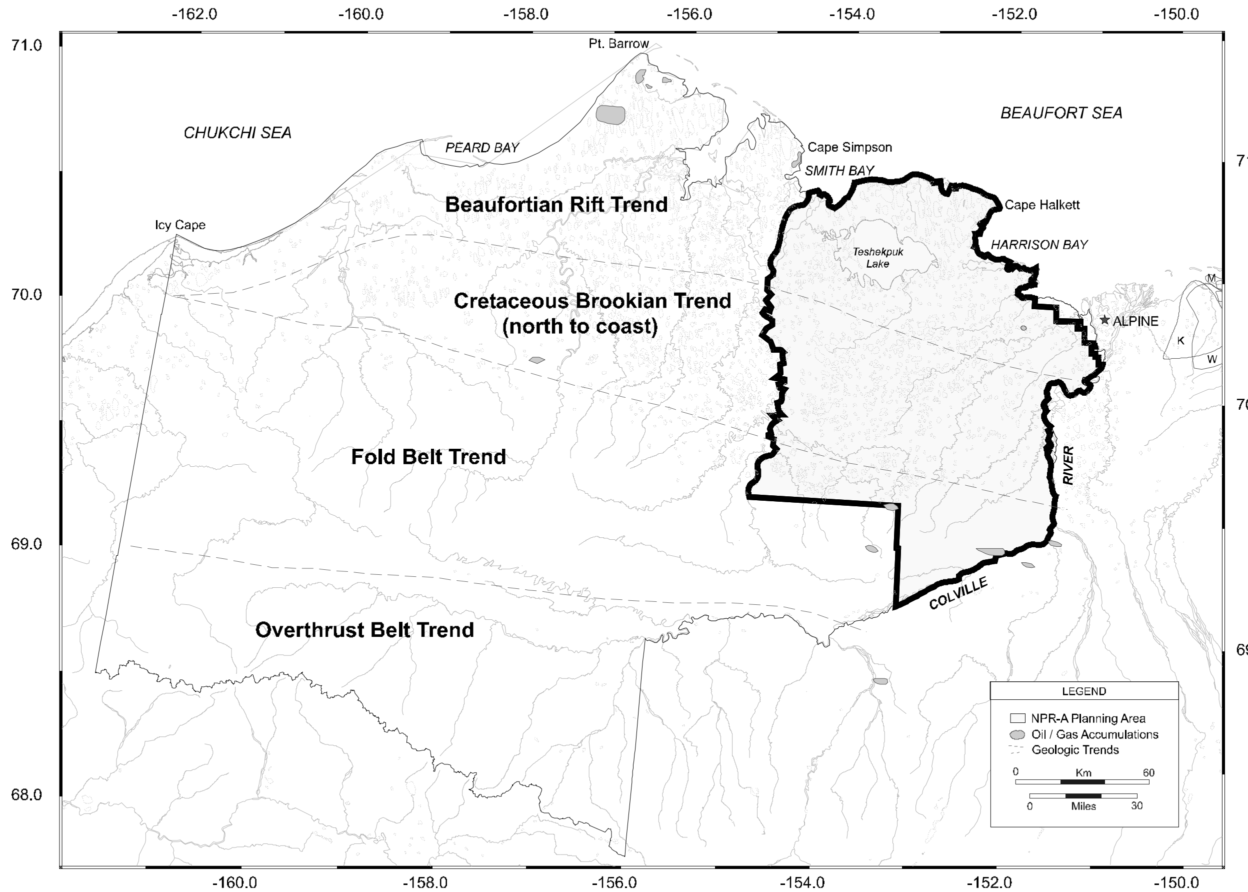


Figure 2. Map showing the eastern NPRA "planning area" described in the February 13, 1997 *Federal Register*. The planning area encompasses about 4.6 million acres. K, M, and W are, respectively, Kuparuk River, Milne Point and West Sak fields.

Status of Renewed Leasing in the NPRA

In a February 4, 1997 meeting, Alaska Governor Tony Knowles and U.S. Department of Interior Secretary Bruce Babbit agreed to cooperate so that renewed NPRA leasing could be quickly evaluated. Shortly after those discussions, the Department of Interior's Bureau of Land Management (BLM) formally announced plans to develop an Integrated Activity Plan and Environmental Impact Statement (IAP/EIS) for about 4.6 million acres in the eastern NPRA (Figure 2). The announcement, published in the February 13, 1997 *Federal Register*, identifies the IAP/EIS action, as well as a Request for Information, and a Call for Nominations and Comments. The tentative schedule calls for comments and information, including industry nominations, by March 31, 1997. The draft IAP/EIS is scheduled to be available for comment October 31, 1997. Several contacts and sources of information are listed below. An NPRA lease sale is currently targeted for the summer of 1998.

1. Map, Information, Comments: Alaska State Office, U.S. Bureau of Land Management (BLM)
   222 West 7th Avenue
   Anchorage, AK 99513-7599 (907)271-3369

2. BLM Anchorage contacts: Jim Ducker (907)271-3369 or jducker@ak.blm.gov
   Curt Wilson (907)271-5546 or c1wilson@ak.blm.gov

3. BLM Web Page: aurora.ak.blm.gov/npra

4. Newsletter or Federal Register notice: BLM External Affairs (907)271-5555

NPRA Background and Leasing History

The NPRA was established in 1923 by President Warren G. Harding's administration. Anticipating the U.S. Navy's need for oil, President Harding set aside the western half of the Alaska Arctic Slope as the Naval Petroleum Reserve No. 4 (NPR-4, or "Pet-4"). The USGS conducted reconnaissance surveys and published geologic maps at the Navy's request. From 1944 to 1953 it undertook a major exploration program, incorporating geophysical surveys and drilling. Prudhoe Bay Field's discovery in 1968 provided new information and geologic concepts that were applied in later NPRA exploration efforts.

In 1974, spurred by the OPEC oil embargo of 1973, the U.S. Navy began a second round of exploration of the NPR-4. Passage by Congress of the Naval Petroleum Reserves Production Act of 1976 transferred the responsibility for the newly redesignated NPRA to the Department of the Interior (DOI). Additional geophysical surveys were conducted and test wells were drilled throughout the reserve, but no commercial oil deposits were discovered.

In 1980, Congress authorized Alaska to receive 50 percent of oil and gas revenues from the NPRA to mitigate the impact of competitive leasing (42 U.S.C. Sec. 6508). Four lease sales were held, 1) Federal Sale No. 821 (1/27/82), 2) Federal Sale No. 822 (5/26/82), 3) Federal Sale No. 831 (7/20/83), and 4) Federal Sale No. 841 (7/18/84). Figure 3 shows the NPRA, its known accumulations, and the broad geologic trends identified as having oil or gas potential. Areas offered in the four NPRA lease sales are also depicted. Because there were several lease sales between 1982 to 1984, they are shown as one large offering encompassing the tracts that received bids. The first NPRA sale offered about 1.5 million acres, 675.8 thousand acres were leased, and total bonuses exceeded $58 million. The second sale offered about 3.5 million acres, 276.4 thousand acres were

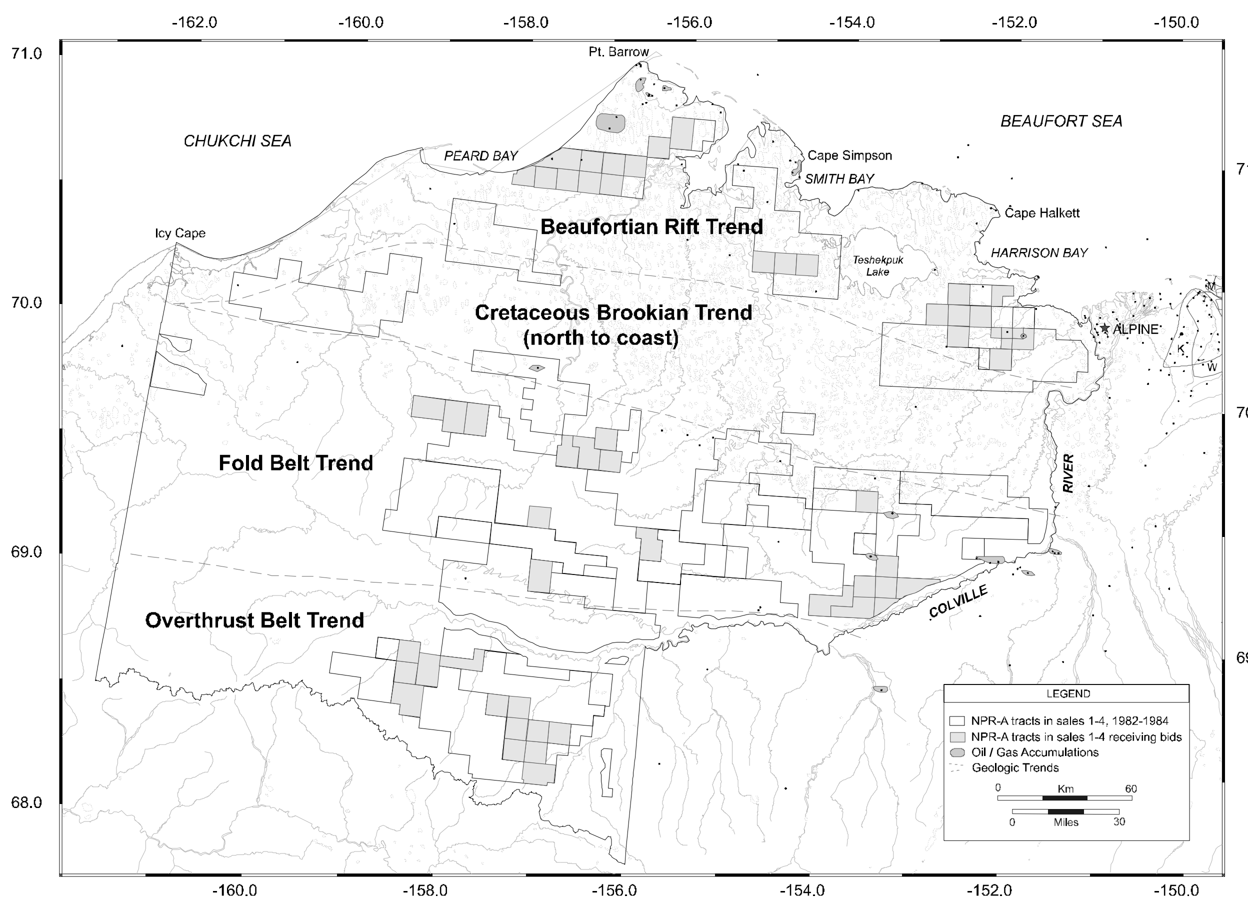


Figure 3. Map showing past federal lease sale offerings and the tracts receiving bids. K, M, and W are, respectively, Kuparuk River, Milne Point and West Sak fields.

leased, and total bonuses exceeded $9.7 million. The third sale offered about 2.2 million acres, 416.4 thousand acres were leased, and total bonuses exceeded $16 million. The last NPRA sale, held in July 1984, offered about 1.6 million acres. No bids were received on any leases. Ten major oil companies bid in these sales. Gulf, Sohio, Shell, Texaco, Placid, and ARCO were the most active participants. Most bids were at the $25 per acre minimum range, but some bids more than doubled that amount. ARCO offered over $95 per acre for one tract south of Barrow along the Meade Arch and later drilled Brontosaurus No. 1 to test their Sadlerochit prospect there. That unsuccessful well, completed March 27, 1985 to a total depth of 6,660 feet, was plugged and abandoned.

The Petroleum Geology of the NPRA

This section contains a brief description of North Slope geology followed by a summary of the overall structure and basin geometry of sedimentary rocks within the NPRA. Additionally, this section includes a discussion of four major geologic trends within the NPRA. These trends provide a framework for describing the petroleum geology of the area. This section also summarizes the known oil and gas accumulations within the NPRA, discusses seismic coverage, and previously published resource estimates.

Geologic research performed by the U.S. Navy and the DOI from the 1940's to 1982 produced a large compendium of geologic knowledge about the NPRA, including field data from rock outcrops in the southern NPRA, information from the drilled exploration wells, seismic interpretations, geochemical data, paleontologic data, and estimates of undiscovered resources (see selected bibliography). We recommend that interested parties acquire "Geology and Exploration of the National Petroleum Reserve in Alaska, 1974 to 1982" (Gryc, 1988, U.S. Geological Survey Professional Paper 1399), for an excellent overview of the results and findings from the U.S. Navy and later USGS exploration programs in the NPRA.

North Slope Framework Geology

Geologic evolution and hydrocarbon occurrence in northern Alaska's arctic regions have been the subject of many technical papers. Eight depositional megasequences (Hubbard, 1987) from Late Devonian to Recent have been identified and correlated with major phases of basin evolution in northern Alaska. These megasequences have been grouped according to stratigraphy, provenance, and tectonic events into three recognized plate sequences (Figure 4): Ellesmerian, Beaufortian, and Brookian.

The Franklinian sequence consists of older, fractured carbonates, argillite, quartzite, and granite that were deformed, uplifted and eroded prior to deposition of the Ellesmerian sequence. This sequence is generally considered the economic basement for potential petroleum accumulations. The Ellesmerian sequence reflects deposition of carbonates and clastics on a subsiding foldbelt terrain (Hubbard, 1987), and includes the northerly-derived, prolific oil producing rocks of the Triassic Ivishak Formation, with reserves of over 12 billion barrels at the Prudhoe Bay Field. Prior to deposition of the Brookian sequence, subaerial exposure of Ellesmerian sequence strata along the Barrow Arch resulted in a progressive northward truncation of much of these strata. These strata were later buried by marine shale, siltstone, and sandstone of the Beaufortian sequence as rifting events switched basin polarity from north to south.

The Beaufortian of early Jurassic through Aptian age records the formation of the oceanic Canada Basin north of Alaska, during a long period (100 Ma) of subsidence and extensional tectonics (Hubbard, 1987). The pattern of basin development during the lower Beaufortian was of northern provenance and major extensional faulting downthrown to the south. Hubbard believes the lower Beaufortian represents a Jurassic failed rift episode. The upper Beaufortian records a second period of extension up to and including the Lower Cretaceous breakup unconformity. The uppermost Beaufortian sequence (post unconformity) evidences the reversal in basin polarity from north to south and the beginning of major down-to-the-north faulting.

The Brookian sequence records the progressive filling of a large east-west trending foreland basin (the Colville Trough) formed in response to thrust loading from the Brooks Range, a large north vergent fold and thrust belt. During the latest Cretaceous and Paleocene, Brookian sediments filled the deep Colville Trough and eventually overstepped the Barrow Arch.

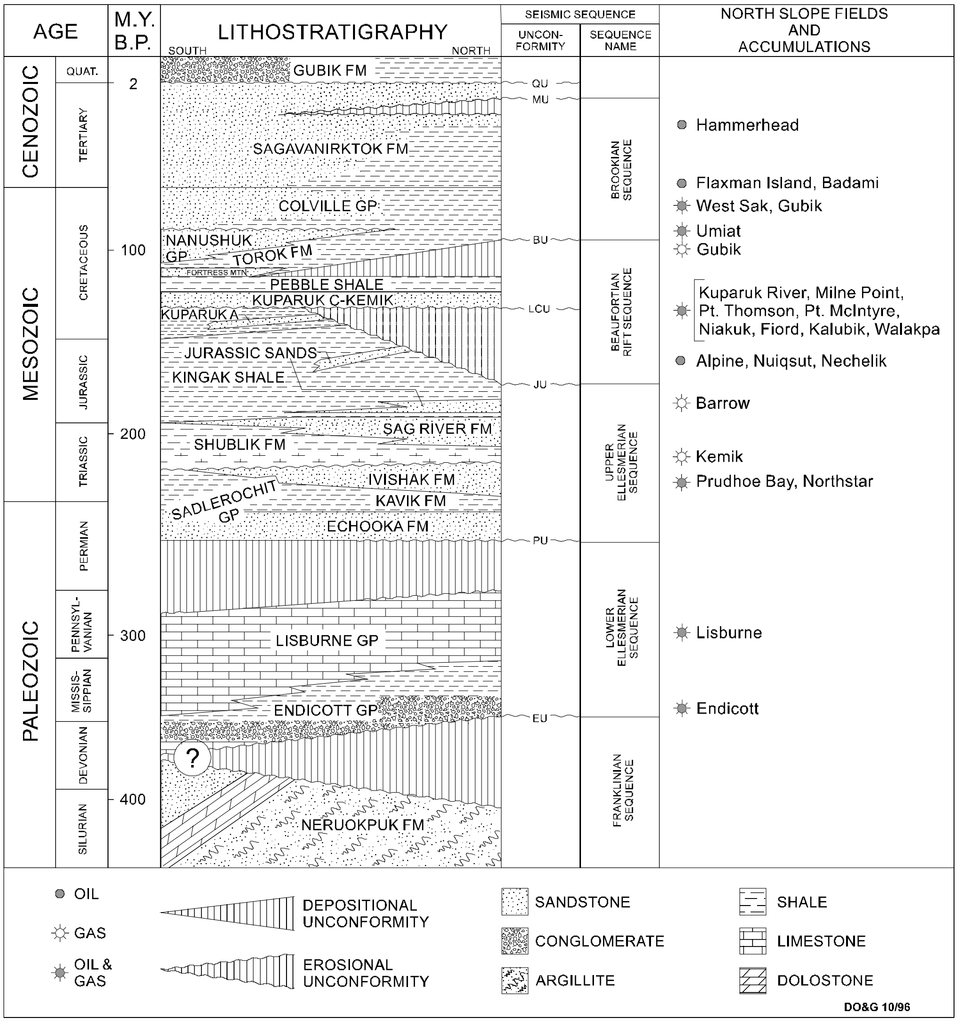


Figure 4. Generalized stratigraphic column for northern Alaska.

Overview of the NPRA Basin Geometry and Geologic Trends

From the standpoint of basin geometry, the NPRA is simplistically characterized by an uplifted south dipping flexure beneath the northern coastline (Barrow Arch). Sedimentary rocks thicken into the deep, east-west aligned Colville trough in the central part of the NPRA. To the south sedimentary rocks filling the Colville trough become progressively more deformed as they are incorporated into a north vergent fold and thrust belt (Brooks Range). The deepest portions of the Colville trough contain Ellesmerian through Brookian strata in excess of 20,000 feet thick. The Barrow Arch is a broad, structural high (flexure) in the Franklinian basement rocks that has elevated all successive strata; it trends for several hundred miles sub-parallel to the northern coastline from Barrow to Prudhoe Bay, and eastward into the Arctic National Wildlife Refuge (ANWR). The northern flank of the Barrow Arch was created by uplift and extension during the period of extensional tectonics which ultimately resulted in the opening of the Canada Basin. The Barrow Arch provides an important structural trapping element for the central North Slope oil fields. That portion of the Barrow Arch complex that lies generally beneath the Colville delta area is informally referred to as the Colville High.

The subsurface in the southern NPRA is characterized by a wedge of Brookian sediments that is generally detached from the Ellesmerian rocks and incorporates a pattern of detachment folds that trend east-west. Structural relief and fold complexity generally increase to the south towards the Brooks Range. The structures in the southern foothills belt are broad, ridge-forming synclines separated by narrow diapiric anticlines, that give way to thrust-faulted and isoclinally folded older rocks of the disturbed belt in the most southern part of the NPRA. Cole and others (1995) provide an excellent north-south structural profile through the NPRA.

Based upon predominant structural style and stratigraphy, the NPRA can be subdivided into four east-west bearing geological areas or trends. These are from north to south: the Beaufortian Rift Trend; the Cretaceous Brookian Trend; the Fold Belt Trend; and the Overthrust Belt Trend; (Figure 5). These trends correspond approximately to the surface physiographic regions: the coastal plain/arctic platform, northern foothills, southern foothills, and Brooks Range. The rocks under the northern two trends are generally autochthonous and have been subdivided into an older Franklinian sequence of pre-Mississippian age; the Mississippian to Jurassic Ellesmerian sequence, the Beaufortian sequence, representing Jurassic through Lower Cretaceous rifting events; and the Brookian sequence that consists of Cretaceous (Albian) and younger clastic rocks. In the southern NPRA, Brookian rocks unconformably overlie older, highly deformed and faulted allochthonous rocks of the Ellesmerian sequence that have been thrust northward from their depositional site.

The Beaufortian Rift Trend consists of fair to excellent quality, potential reservoir rocks of Jurassic through Lower Cretaceous age, which are already known to be productive in northern Alaska. Anticipated traps include purely stratigraphic, as well as combination structural/stratigraphic traps, formed in part as a result of the failed rifting and successful rifting events. Good examples of accumulations within this trend, but outside of the NPRA, are the Kuparuk River, Milne Point, Point McIntyre, Point Thomson, and Niakuk fields, as well as the Colville Delta, Fiord, Kalubik, and Alpine discoveries. Within the NPRA, known gas accumulations include the East Barrow, South Barrow, Sikulik and Walakpa fields (Figure 5). In light of the nearby discoveries, this trend is particularly attractive in the region adjoining the northeastern NPRA boundary. The potential for reservoir sands in this interval, however, exists along the entire trend from the Barrow area to the Colville delta.

The Cretaceous Brookian Trend consists dominantly of stratigraphically trapped oil or gas in sandstone reservoirs of fairly low porosity and permeability. The trend contains two small known oil accumulations within the NPRA (Simpson and Fish Creek) and has tested oil in other wells including Texaco Colville Delta No. 3, east of the NPRA. The northernmost portion of this trend overlies the Beaufortian Succession Rift Trend and can afford secondary targets that may help to mitigate drilling risk in this region.

The Fold Belt Trend consist primarily of the same and younger Cretaceous sandstones of the Brookian Succession Trend. Traps are dominantly broad, anticlinal structures, some of which are breached at higher levels. The potential sandstone reservoirs are dominantly litharenites. Six known oil and gas accumulations are found within or on the border of the NPRA within this trend. These are Umiat, East Umiat, Gubik, Wolf Creek, Square Lake, and Meade. Only Umiat has had any significant amount of delineation drilling.

The Overthrust Belt Trend consists of Mississippian carbonate and Cretaceous clastic reservoirs found in large compressional structures bounded by thrust faults. This trend is somewhat analogous to the overthrust play in the western U.S. The disturbed-belt in the southern NPRA contains very complex structures; due to relatively high thermal maturity of source and reservoir rocks, the trend is considered to be dominantly gas-prone. Lisburne No. 1, located just outside the southeast boundary of the current NPRA border (Figure 5; Appendix D), drilled in this trend and penetrated at least five thrust-faulted repetitions of the Lisburne Group carbonates (See Cole and others, 1995, for a structural reconstruction through this well). The well encountered ubiquitous dead-oil shows and had gas shows from several horizons. Additionally, porous dolomites of the Lisburne Group containing oil have been documented in a number of outcrop localities within the Overthrust Belt Trend (Mull, per. comm.). The East Kurupa well (Figure 5; Tables 1 and 2), located just south of the NPRA, tested gas from the Lower Cretaceous Fortress Mountain Formation.

Known Oil and Gas Accumulations within the NPRA

The geologic potential of the NPRA to contain commercially developable oil has not yet been proven. The South Barrow, East Barrow, and Walakpa Fields are, however, producing. The North Slope Borough operates them for the benefit of local residents at Barrow. Ten gas accumulations and three oil accumulations have been discovered in and near the NPRA since initial exploration began in 1944 (Tables 1 and 2). Some accumulations are discussed only because of repeated reports of their “discovery”. Low test rates, shallow depths, and remote locations render these “discoveries” economically insignificant. The largest known oil accumulation, which is estimated to contain about 70 million barrels of recoverable oil, is located at Umiat.

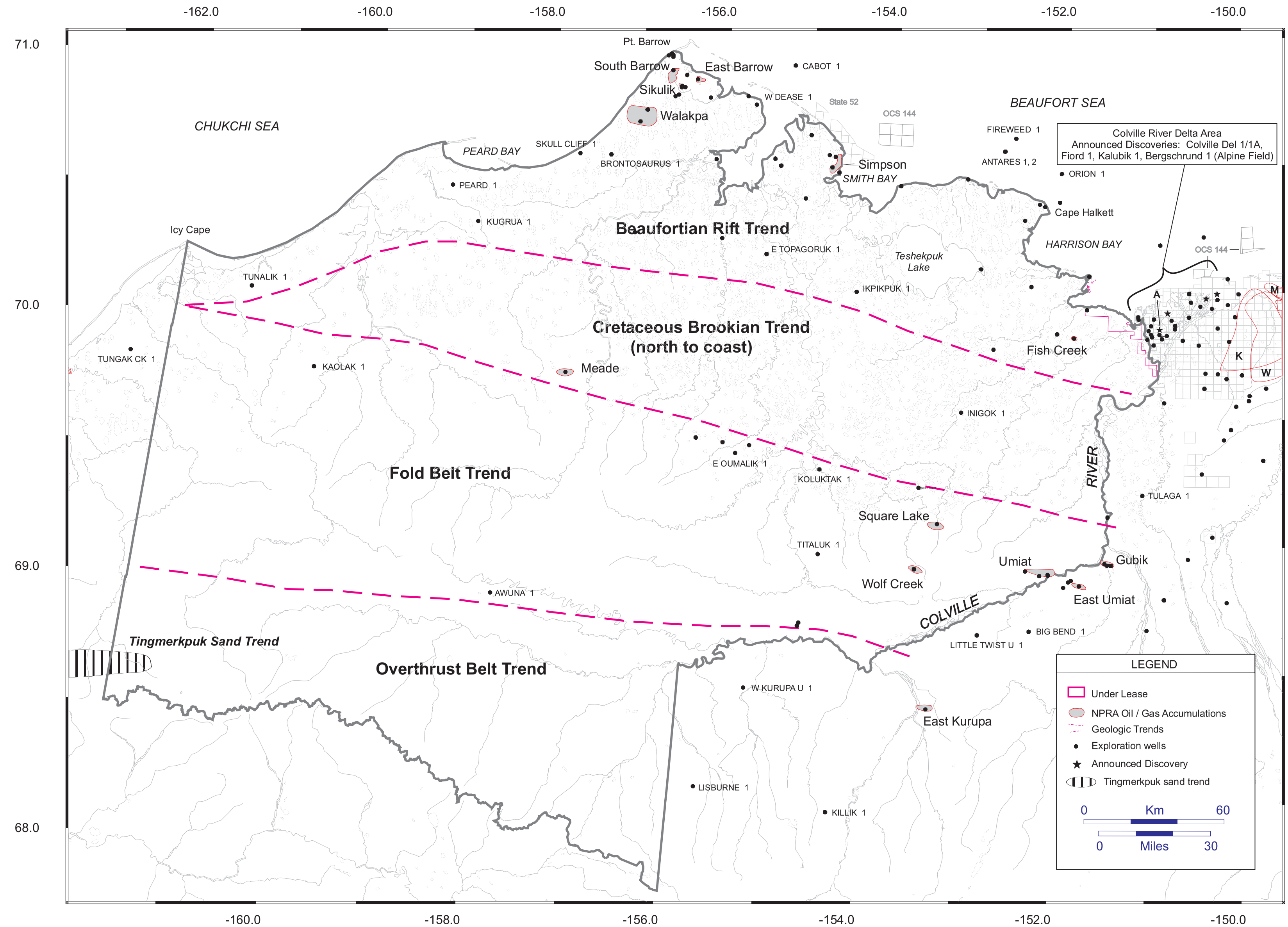


Figure 5. Map showing the well locations; known NPRA accumulations; announced discoveries on the Colville River Delta; active state and federal leases; and the four broad structural trends. A is the Alpine Field (Bergschrund No. 1 is the discovery well). K, M and W are, respectively, Kuparuk River, Milne Point and West Sak fields. Note that the southeastern NPRA boundary is from the 1991 survey. According to this survey, Lisburne No. 1 is outside of the NPRA (Appendix D).

Accumulation Name	Est. Recov. Reserves Oil, mmbo	Gas, bcf	Information Source	Formation or Group	Approx. Depth	API Gravity	Major Fluid Type
Sikulik		12	USGS, 1996	Barrow SS	2100		Gas
Walakpa		180	Imm, 1996	Walakpa SS	2000		Gas
East Kurupa				Torok/Fortress Mt.	7150; 8950		Gas
East Barrow		12.6	Thomas, et al., 1993	Barrow SS	2000		Gas
East Umiat		4	Thomas, et al., 1993	Nanushuk Gp.	1900	31	Gas
Square Lake		58	Thomas, et al., 1993	Seabee Fm.	1650		Gas
Gubik		600	Thomas, et al., 1993	Prince Ck./Chandler	1700; 3500		Gas
Wolf Creek				Chandler Fm.	1500		Gas
Simpson	12		Kornbrath, 1995	Nanushuk Gp.	300	24	Oil
Meade		20	Thomas, et al., 1993	Nanushuk Gp.	1000		Gas
Umiat	70	5	Thomas, et al., 1993	Grandstand Fm.	200	36	Oil
Fish Creek				Nanushuk Gp.	2900	14	Oil
South Barrow		25.9	Thomas, et al., 1993	Barrow SS	2340	41	Gas

Table 1. Oil and gas accumulations in or near the NPRA showing estimated recoverable reserves where available, productive unit, depth, oil gravity and fluid type. East Kurupa, Gubik and East Umiat are included, but located outside the NPRA.

Accumulation Name	Operator Name	Discovery Well Name	Well API Number	Discovery Date	Oil Rate (bopd)	Gas Rate (mcfpd)
Sikulik	N S Borough	S Barrow NSB-5	50023200250000	4/18/88		130
Walakpa	Husky	Walakpa No. 1	50023200130000	2/7/80		340
East Kurupa	Texaco	East Kurupa No. 1	50137200020000	3/1/76		3800; 1300
East Barrow	US Navy	S Barrow No. 12	50023200060000	5/4/74		2400
East Umiat	McCulloch	E Umiat No. 1	50287100160000	3/28/64		3500
Square Lake	US Navy	Square Lake No. 1	50119100070000	4/18/52		112
Gubik	US Navy	Gubik Test No. 1	50287100130000	8/11/51		2060; 3384
Wolf Creek	US Navy	Wolf Ck. No. 1	50119100080000	6/4/51		881
Simpson	US Navy	Simpson No. 26	50279100020000	10/23/50	110	
Meade	US Navy	Meade No. 1	50163100020000	8/21/50		1100
Umiat	US Navy	Umiat No. 4	50287100030000	7/29/50	200	
Fish Creek	US Navy	Fish Ck. No. 1	50103100010000	9/4/49	12	
South Barrow	US Navy	S Barrow No. 2	50023100100000	4/15/49		4100

Table 2. Oil and gas accumulations in or near the NPRA showing discovery well and date, and test rates where available. East Kurupa, Gubik and East Umiat are included, but located outside the NPRA.

The earliest drilling in the NPRA generally targeted shallow, Cretaceous marine shelf sands and tested anticlines at their surface expression near known oil seeps. Gravity and seismic data (one- and six-fold dynamite) were also used for prospect generation. Most of the NPRA discoveries were made in reservoirs within the Lower Cretaceous Nanushuk Group or in Jurassic sandstones within the Kingak Shale.

South Barrow, East Barrow and Sikulik Gas Fields

In 1949, South Barrow Field was discovered by South Barrow No. 2. Nearby subsequent drilling discovered the East Barrow Field in 1974 and the Sikulik accumulation in 1988. The South Barrow, East Barrow and Sikulik reservoirs are all within the informally named Barrow sandstone at depths between 2,200 and 2,400 feet. The Barrow sandstone is a very fine grained, argillaceous, bioturbated sand located at the base of the Jurassic Kingak Shale. It was probably deposited as a series of offshore bars. This sand rests unconformably on top of the Triassic Sag River Formation. These fields are located on anticlines that abut against a disturbed zone, also known as the Avak structure. This structure is named after U.S. Navy Avak No. 1 which penetrated this zone of chaotic to nonexistent seismic reflectors. The Avak structure has the shape of an impact crater, and, filled with impermeable mud, provides part of the trapping mechanism for all of these accumulations. Carbon isotope data indicate that these accumulations are thermal gas rather than biogenic gas. This is unusual because the reservoir is surrounded by thermally immature mudstone (Bird, 1988).

Fish Creek Oil Field

In 1949, U.S. Navy Fish Creek No. 1 was drilled at the site of the Fish Creek oil seep to a depth of 7,020 feet. This well has been called a discovery, but should be characterized as an encouraging show. Heavy oil that has an asphalt base at 13 to

14 degrees API gravity flowed from an interval between 2,915 and 3,020 feet at a rate of approximately 12 barrels of oil per day. Testing of lower oil zones at approximately 5,500 and 6,000 foot depths failed and was discontinued after several attempts. Because of the poor production tests, the accumulation has been given no reserve estimates. The reservoir interval is within the Albian Nanushuk Group, in a small listric fault trapping structure (Kirschner and Rycerski, 1988).

Meade Gas Field

In 1950, U.S. Navy Meade No. 1 was completed to a depth of 5,305 feet. It was drilled near the northernmost part of the Fold Belt Trend in a fairly long, narrow, and asymmetric anticline identified by seismic mapping. Traces of oil and gas were observed during drilling. Testing resulted in a gas flow rate of 1,100 thousand cubic feet per day from Nanushuk Group rocks. It is unknown whether the gas in this field is thermal or microbial in origin.

Umiat Oil Field

In 1950, the Umiat accumulation was discovered by U.S. Navy Umiat No. 4. The reservoir limits have been fairly well delineated by subsequent drilling. Reserve estimates of producible oil range from 30 million to over 100 million barrels of oil (Miller, Payne and Gryc, 1959). Current average estimated reserves are 70 million barrels of oil. The reservoir rock consists of the Grandstand Formation (Nanushuk Group) sandstones at a shallow depth. These fine to very fine-grained marine sandstones were deposited in a deltaic setting. The trapping structure at Umiat is an east-west trending, thrust-faulted anticline located in the Fold Belt Trend. The oil source is believed to underlie Torok Shale and/or Lower Cretaceous Pebble Shale (Magoon, 1994).

Simpson Oil and Gas Fields

Oil seeps located on the Simpson Peninsula were a major factor in leading to the establishment and exploration of the NPRA. From 1945 to 1951, a total of 33 shallow test holes ranging in depth from 115 to 2,505 feet were drilled by the U.S. Navy in the vicinity of the oil seeps. The objective was to obtain structural and stratigraphic information and to determine the origin of the oil. Oil was found in several holes at shallow depths trapped in very porous sandstone beneath an erosional unconformity of considerable relief. Initial production from the discovery well, U.S. Navy Simpson No. 26, was 110 barrels per day from a perforated interval between 289 and 325 feet. Seismic studies and results of the drilling in the area indicate that the Simpson accumulation occurs in a truncation trap on the eastern, downdip margin of the Simpson paleocanyon (Kirschner and Ryserski, 1988).

Wolf Creek, Square Lake and East Umiat Gas Fields

Several wells were drilled on structures surrounding the Umiat Field subsequent to discovery of oil there. U. S. Navy Wolf Creek No. 1 and McCullough East Umiat No. 1 tested Nanushuk Group sands and discovered gas at depths of 1,500 and 1,900 feet respectively. U.S. Navy Square Lake No. 1 tested sands in the Seabee Formation with an encouraging show that flowed gas at a rate of 112 thousand cubic feet per day.

Gubik Gas Field

The discovery of the Gubik accumulation occurred with the drilling of U.S. Navy Gubik No. 1, completed in 1951. Gas was discovered at three horizons, the Prince Creek Formation and Chandler and Ninuluk formations. It is unknown whether the gas in this field is thermal or microbial in origin.

East Kurupa Gas Field

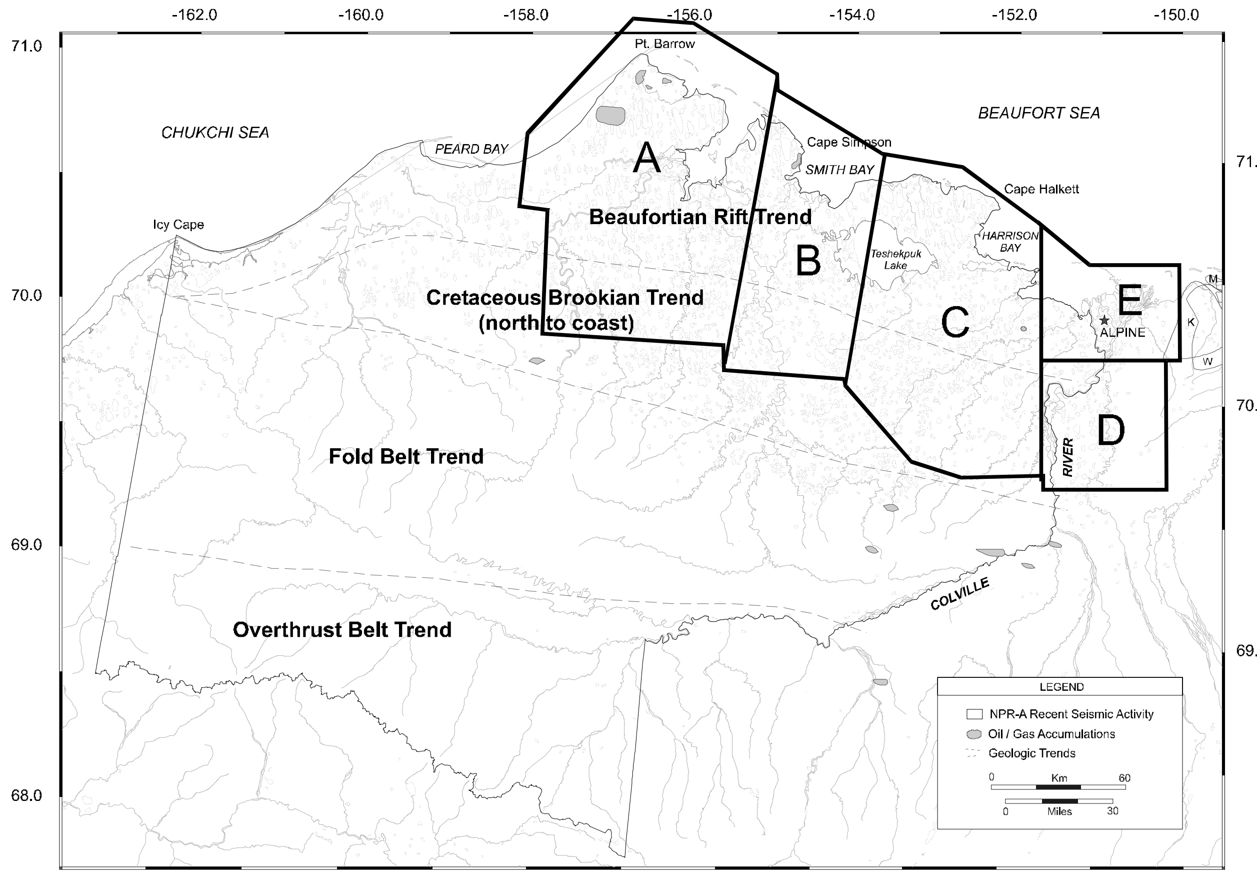
Texaco East Kurupa No. 1 discovered gas in the Albian Fortress Mountain Formation at two separate intervals, 7,150 and 8,950 feet. This well is located south of the eastern NPRA, but is an important discovery in the Overthrust Belt Play that extends to the west into the NPRA. No public seismic data are available over this accumulation and information on the trapping mechanism has not been released to the public.

Walakpa Gas Field

The Walakpa Field was discovered with the drilling of Husky Walakpa No. 1 in 1980. This well flowed gas at 340 thousand cubic feet per day from 20-25 ft. of net pay at a depth of 2,070 feet. The productive interval in the Walakpa Field is the Walakpa sandstone, interpreted to be a marine shelf sand and a Kuparuk Formation equivalent that rests unconformably on the Jurassic Kingak Shale. The trapping mechanism is somewhat ambiguous. The Walakpa Field is interpreted as being a combination structural and stratigraphic trap somewhat like the Kuparuk River Field. Reserves have been conservatively estimated at 142-180 bcf gas (Imm, per. comm.).

Seismic Surveys in the NPRA

Seismic surveys shot for the federal government between 1944 and 1981 cover most of the NPRA. Much of this 2-D data, however, is old and not nearly of the same quality as recent surveys. From 1944 to 1953 United Geophysical collected seismic survey data for the U.S. Navy. From 1972 to 1981, the USGS employed Geophysical Service Inc. to conduct eight



Permit	Survey Name	Permitee	Contractor	Miles	Start	Finish	Status	Area
91015	Kuparuk to Colville - 2D	ARCO	Western	300	1/8/92	4/11/92	Done	D, E
92020	Harrison Bay - 2D	ARCO	Western	301	2/25/93	4/20/93	Done	B,C,D,E
92018	Colville Delta - 2D	ARCO	Western	257	1/1/93	4/24/93	Done	E
93014	NPRA Colville - 2D	ARCO	Western	252	1/22/94	3/8/94	Done	A,B,C,D,E
94007	NPRA Colville Delta - 2D	ARCO/Western	Western	327	12/31/94	3/31/95	Done	D,E
95010	Colville - 3D	ARCO	Western	152 sq.	12/16/95	5/6/96	Done	C,D,E
95015	NPRA - 2D	ARCO	Western	178	3/27/96	5/1/96	Done	C,D
96010	Colville to Barrow - 2D	ARCO	Western	1000	1/15/97		Active	A,B,C,D,E

Figure 6. Map and table showing areas of post-1990 seismic survey activity. K, M, and W are, respectively, Kuparuk River, Milne Point and West Sak fields.

large regional seismic surveys and two smaller surveys (Gryc, 1988). Combined, these surveys cover virtually all of the NPRA. Most of the USGS data is publicly available through the U. S. Geological Survey National Energy Research Seismic Library, P.O. Box 25046, MS-960, Denver, Colorado 80225-0046.

Within the last five years, the oil industry has acquired a substantial amount of new seismic data in northcentral and the northeastern NPRA. In 1992, Western Geophysical began shooting seismic surveys covering the northern part of the NPRA from the Colville delta to the Point Barrow area. Figure 6 shows the approximate locations and a listing of the most recent seismic surveys. Many previous seismic surveys were shot in the same area (Because a comprehensive list of issued state and federal seismic permits is lacking, compiling a history of seismic exploration activity in the NPRA is difficult, and has not been attempted by the authors of this paper). Areas C, D, and E represent intensely resurveyed portions of the NPRA. The rest of the NPRA, including some portions of the outlined area, have not been surveyed using modern seismic exploration equipment and techniques. Seismic data obtained by private parties in the NPRA remain confidential.

The Last Published Resource Estimates Specifically for the NPRA Were Completed in 1980

The most recent estimates of undiscovered oil and gas in the NPRA by federal geoscientists were completed in 1978 and 1980 using play analysis methodology (Tables 3 and 4) (Gryc, 1988). Earlier assessments were considered overly optimistic, having been greatly influenced by the supergiant Prudhoe Bay discovery. These latest estimates reflected the realization that the unique combination of structural and stratigraphic characteristics at Prudhoe Bay Field were unlikely to be found in the NPRA, in addition to the negative results of the federal drilling programs. No new assessment has incorporated the more recent drilling results on the Colville delta adjacent to the NPRA (Figrue 7), or seismic data acquired in this decade. It is important to note that the USGS's 1995 National Assessment of United States Oil and Gas Resources (Circular 1118) does not estimate undiscovered resources specifically for the NPRA. Instead it consolidates previously subdivided provinces in Alaska into a simple three-province scheme. It treats the NPRA as a portion of the Northern Alaska province. Again, it pre-dates the recent encouraging drilling information from the Colville delta area.

Source/Date/Type	95-Percent	5-Percent	**Mean**
DOI, 1978 In-Place:	1.1	20.5	**7.0**
Recov. :	*0.4*	*7.2*	***2.5***
USGS, 1980 In-Place:	0.8	15.4	**6.0**
Recov. :	*0.3*	*5.4*	***2.1***

Table 3. Estimates of in-place and recoverable oil in the NPRA in billions of barrels (modified from Gryc, 1988). DOI is the Department of the Interior, USGS is the United States Geological Survey.

Source/Date/Type	95-Percent	5-Percent	**Mean**
DOI, 1978 In-Place:	4.2	28.7	**13.7**
Recov. :	*3.2*	*21.5*	***10.3***
USGS, 1980 In-Place:	2.4	27.2	**11.3**
Recov. :	*1.8*	*20.4*	***8.5***

Table 4. Estimates of in-place and recoverable gas in the NPRA, in trillion cubic feet (modified from Gryc, 1988).

One point made by Gryc (1988) regarding the NPRA's potential still applies:

> An overall assessment of the oil and gas potential of the NPRA on the basis of past exploration indicates that an easily defined giant oil or gas prospect may not be present. However, the reserve has only been partly explored, and evaluations may change in the light of new concepts. Detailed seismic stratigraphy will probably play a major role in defining any new prospects.

The Colville River Delta Area - Petroleum Geology of Recent Discoveries

This section describes the petroleum geology of four discoveries in the Colville River delta area immediately to the east of the NPRA. Included in this discussion are drilling history, test results, summary of reservoir parameters, two key cross sections through the area, a detailed stratigraphic column, and a generalized interpretation of the environment of deposition for key reservoirs.

Four discoveries have been announced in the Colville delta area (Figure 7). These are ARCO Bergschrund No. 1 (Alpine Field), Texaco Colville Delta No. 1 and 1A, ARCO Fiord No. 1, and ARCO Kalubik No. 1.

Alpine Field

In October 1996, ARCO, Anadarko, and UTP (collectively referred to as “Alpine partners”) announced details of the Alpine Field discovery in the western Colville delta area, 34 miles west of the Kuparuk River Field. The Alpine partners estimated one billion barrels of oil in place and 250-300 million barrels of oil reserves in the informally named Alpine sandstone. Bergschrund No. 1 discovery well was completed April 14, 1994 to a depth of 7,502 feet (measured depth) on state lease ADL-25558. The well data were publicly released on December 31, 1996. The field is slated for production startup in early 2000. Initial production is estimated at 30,000 barrels of oil per day and is expected to increase to 60,000 barrels of oil per day in 2001. Two drill sites and a pipeline to the Kuparuk River Field are planned. Development costs are expected to be about $700-$800 million. Following is the history of leasing and exploration of the Alpine Field and other discoveries in the Colville delta area.

Prior to the drilling of Bergschrund No. 1, several oil-bearing sandstone reservoirs had been penetrated in wells to the northeast of the Bergschrund location. These reservoirs include deep water sandstones of the Lower Cretaceous (Aptian - Albian) Torok Formation, shoreface and foreshore sandstones of Lower Cretaceous (Hauterivian) Kuparuk Formation (C member), and/or shelf sandstones of the Upper Jurassic Nechelik and Nuiqsut intervals. Bergschrund No. 1 penetrated approximately six feet of tight Kuparuk C sandstone at 6,786 feet (md) measured depth above a regional Lower Cretaceous unconformity (LCU) at 6,790 feet (md). At 6,876 feet (md) or -6,835 feet subsea, the oil-bearing Upper Jurassic Alpine sandstone was encountered. Continuing down, the well penetrated tight siltstone in the Nuiqsut interval at 7,090 feet (md) and 18 feet of oil-bearing sandstone in the Nechelik interval at 7,349 feet (md). The stratigraphic position of these intervals is depicted on Figure 8, which is a detailed stratigraphic column for the Colville delta area.

In this paper the authors define the Alpine interval as the interval in Bergschrund No. 1 from the maximum gamma ray inflection immediately above the top of the Alpine sandstone to the top of the maximum gamma ray inflection immediately above the Nuiqsut sandstone (Figures 9, 10 and 11). Similarly, the Nuiqsut interval is defined as the interval in Bergschrund No. 1 from the maximum gamma ray inflection immediately above the top of the Nuiqsut sandstone to the maximum gamma ray inflection immediately above the top of the Nechelik sandstone (Figures 9, 10 and 11).

In Bergschrund No. 1, the Alpine interval contains about 47 feet of net pay (10 percent porosity cutoff) and has a net sandstone to gross sandstone ratio of about 90 percent. The entire Alpine sandstone was oil bearing; no oil water contact or evidence of a gas cap was indicated in the well. The Alpine sandstone was tested at a rate of about 2380 barrels of 40 degree API oil per day on a 128/64-inch choke with a gas-to-oil ratio (GOR) of about 769. Other reservoir properties for the Alpine sandstone are summarized in Table 5.

Based on an analysis of sidewall cores from Bergschrund No. 1, the Alpine sandstone is moderate to well sorted, very-fine to fine-grained, quartz arenite containing a trace to 15 percent glauconite. Log analysis reveals that the Alpine sandstone contains significantly less internal clay than the underlying Nuiqsut and Nechelik intervals. The log character and the regional geologic setting of the Alpine sandstone suggests that it was deposited in an inner shelf environment (see the following section on stratigraphy and sedimentology for more details).

Following the drilling of the discovery well, the Alpine partners drilled an additional 9 Alpine delineation wells. These wells are: Alpine No. 1, Alpine No. 1A, Alpine No. 1B, Fiord No. 3 and Fiord No. 3A, all drilled in 1995; and Neve No. 1, Alpine No. 3, Bergschrund No. 2, and Bergschrund No. 2A, drilled in 1996 (PI, 10/9/96). Other wells drilled by the Alpine partners in the area in 1996 include Nanuk No. 1; Temptation No. 1; and Temptation No. 1A. The results of all these wells are currently confidential.

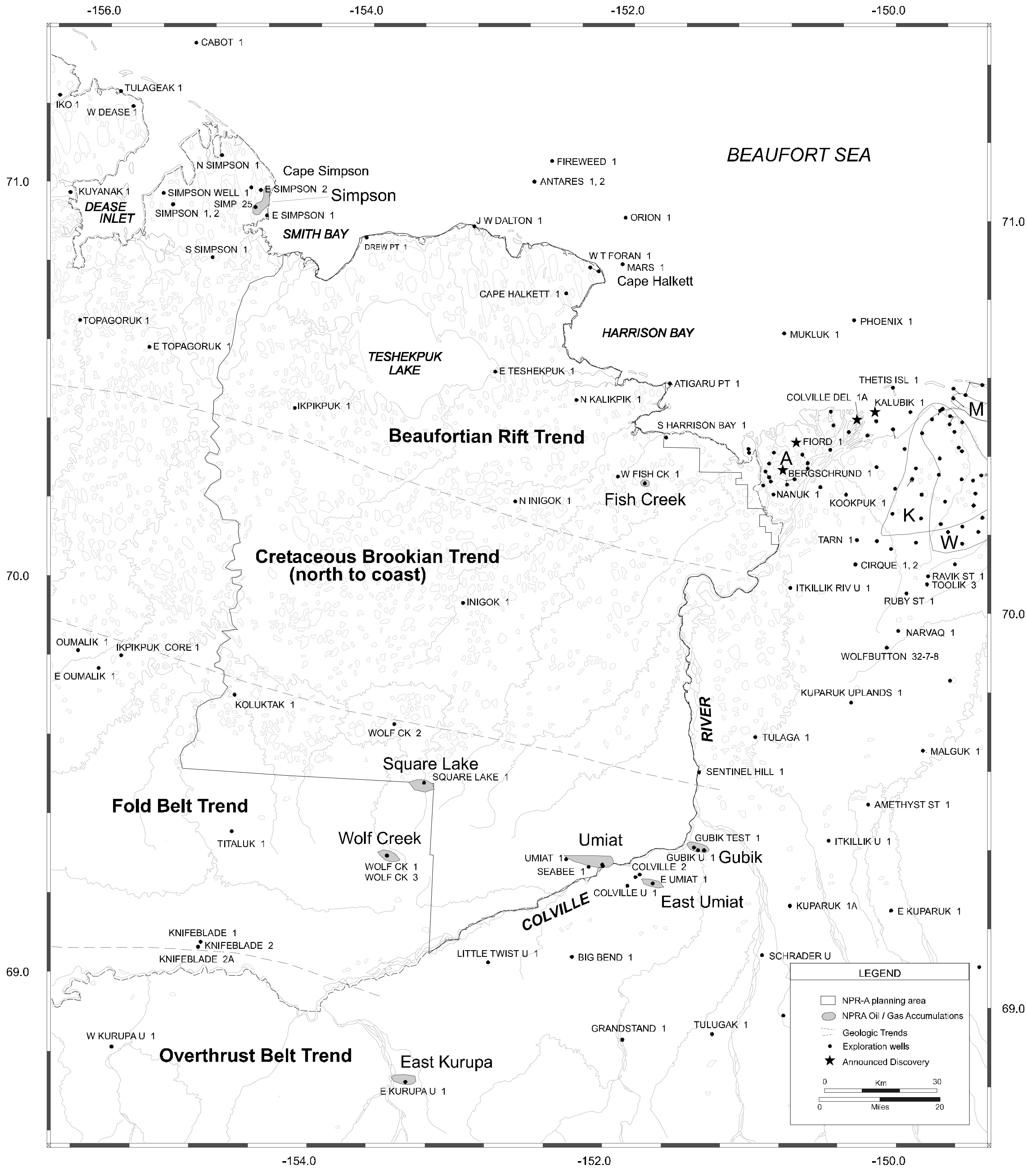


Figure 7. Map showing the NPRA planning area, geologic trends, and significant wells. A is the Alpine Field (Bergschrund No. 1 is the discovery well). K, M, and W are, respectively, Kuparuk River, Milne Point and West Sak fields.

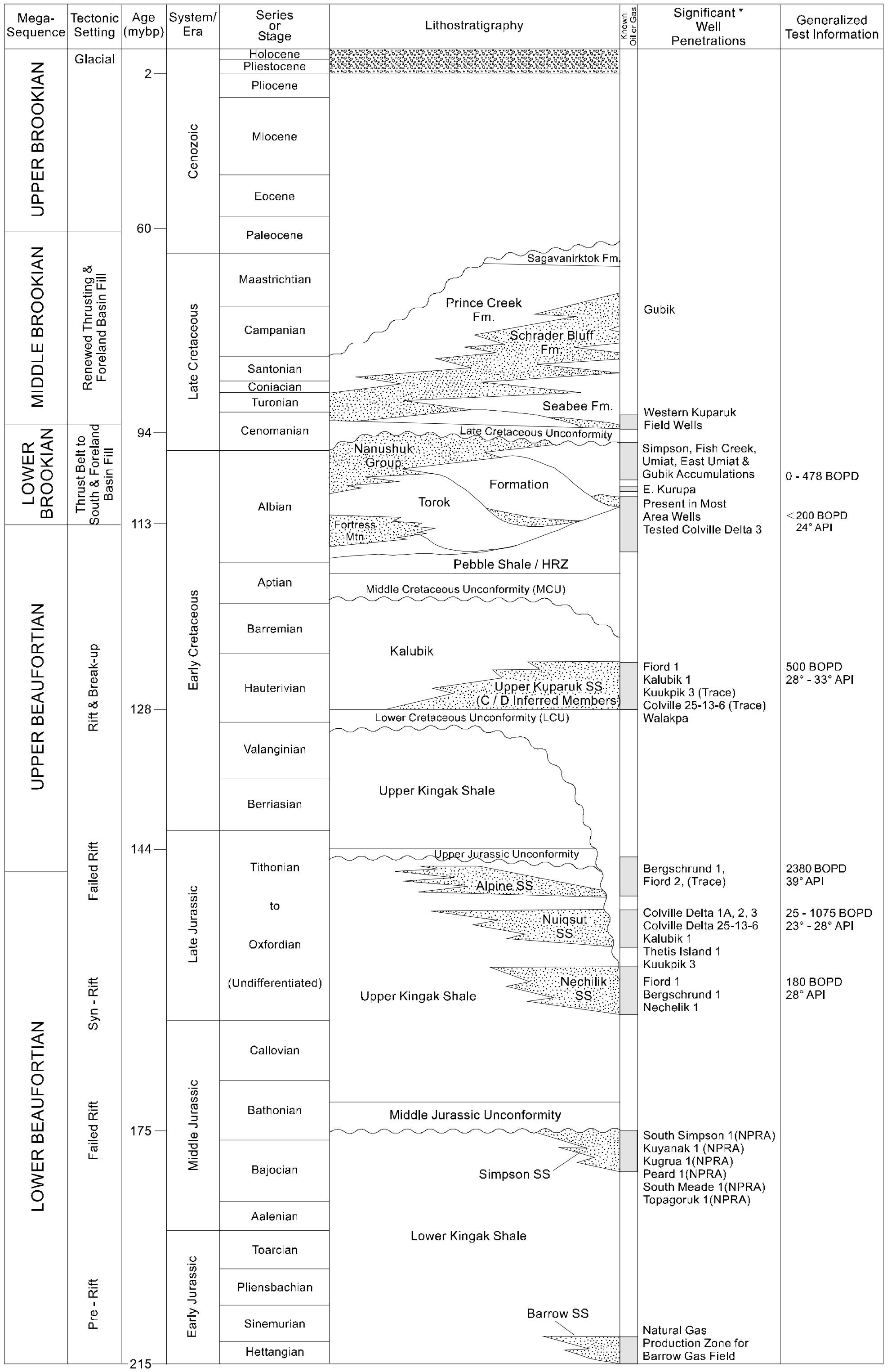


Figure 8. Detailed Early Jurassic through Cenozoic stratigraphic column for the northern NPRA and Colville delta areas. * Well penetrations generally within and near the NPRA.

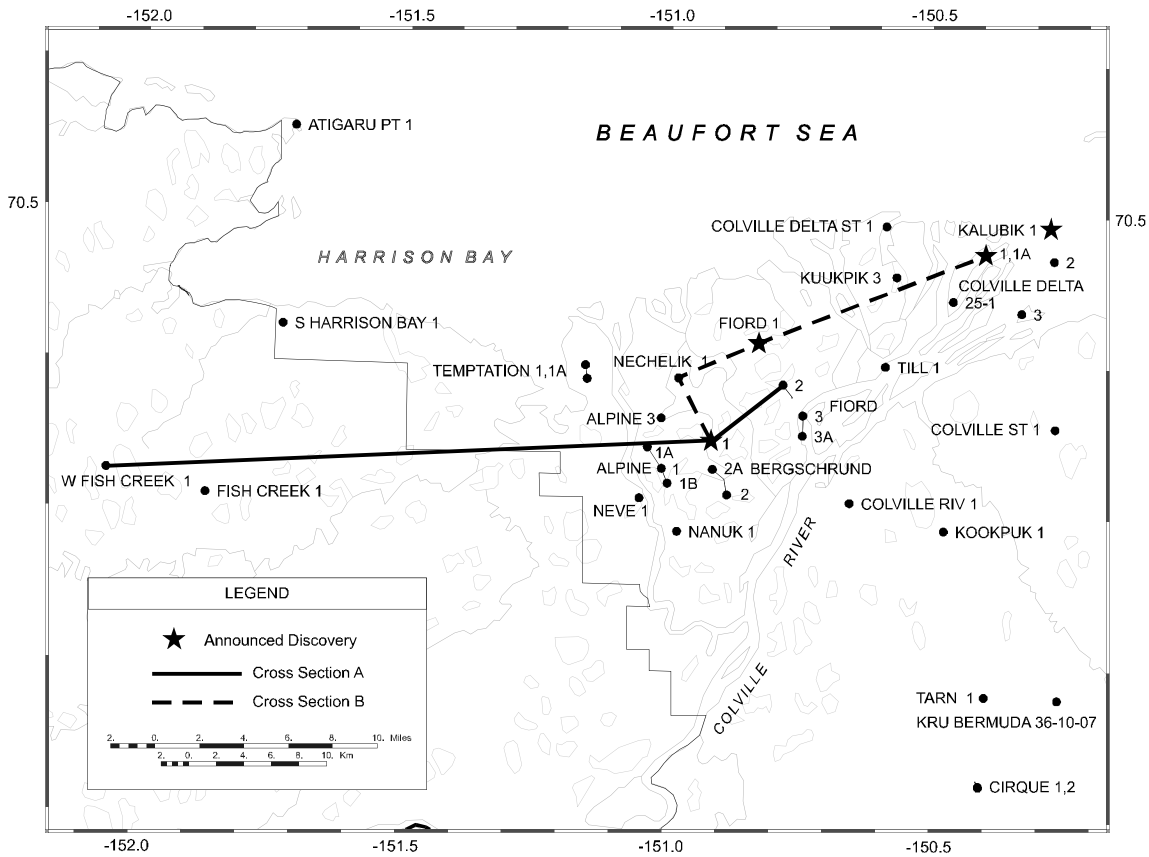


Figure 9. Detailed map showing the location of two cross sections and the Colville delta area exploration wells.

Other Colville Delta Discoveries

Texaco Colville Delta No. 1 flowed up to 1,075 barrels of oil per day (bopd) and 391,000 cubic feet of gas per day on 32/64-inch choke from approximately 95 feet of net pay sandstone in the Jurassic Nuiqsut sandstone, an informally named sandstone within the Kingak Shale. In 1985 and 1986, four additional delineation wells were drilled, three by Texaco and one by Amerada Hess. All four wells, Texaco Colville Delta No. 1A, No. 2, No. 3 and Amerada Hess Colville Delta 25-13-6 encountered oil-bearing Nuiqsut sandstone. For typical reservoir properties for the Nuiqsut sandstone see Table 5.

ARCO Fiord No. 1 was completed April 13, 1992, to a total depth of 10,250 feet (md). ARCO Kalubik No. 1 was completed May 1, 1992 to a total depth of 8,273 feet (md). On December 21, 1992, ARCO announced that both wells discovered oil in the Lower Cretaceous Kuparuk Formation. Fiord No. 1 had an average flow rate of 1,065 barrels of oil per day through a 24/64-inch choke of 33 degree API gravity oil with a GOR of 500 standard cubic feet of gas per standard barrel of oil from 26 feet of net pay in the Kuparuk Formation (600 pounds per square inch wellhead pressure), and had an average flow rate of 180 barrels of oil per day through an 18/64-inch choke of 28 degree API gravity oil after hydraulic fracturing (50 psi wellhead pressure) from the Late Jurassic Nechelik sandstone. A follow up well, Fiord No. 2, was completed in 1994 with disappointing results. The well encountered no net pay in the Kuparuk Formation but did drill through approximately six feet of oil bearing Alpine sandstone (Table 5). Kalubik No. 1 flowed at an average rate of 1,200 barrels of oil per day through a 32/64-inch choke of 26 degree API gravity oil at a GOR of 450 and a wellhead pressure of 380 psi from 30 feet of net pay sandstone in the Kuparuk Formation. After hydraulic fracturing, 75 feet of net pay in the Nuiqsut sandstone had an average flow rate of 410 barrels of oil per day through a 12/64 inch choke of 21 degree API gravity oil at a GOR of 250 and a wellhead pressure of 315 psi.

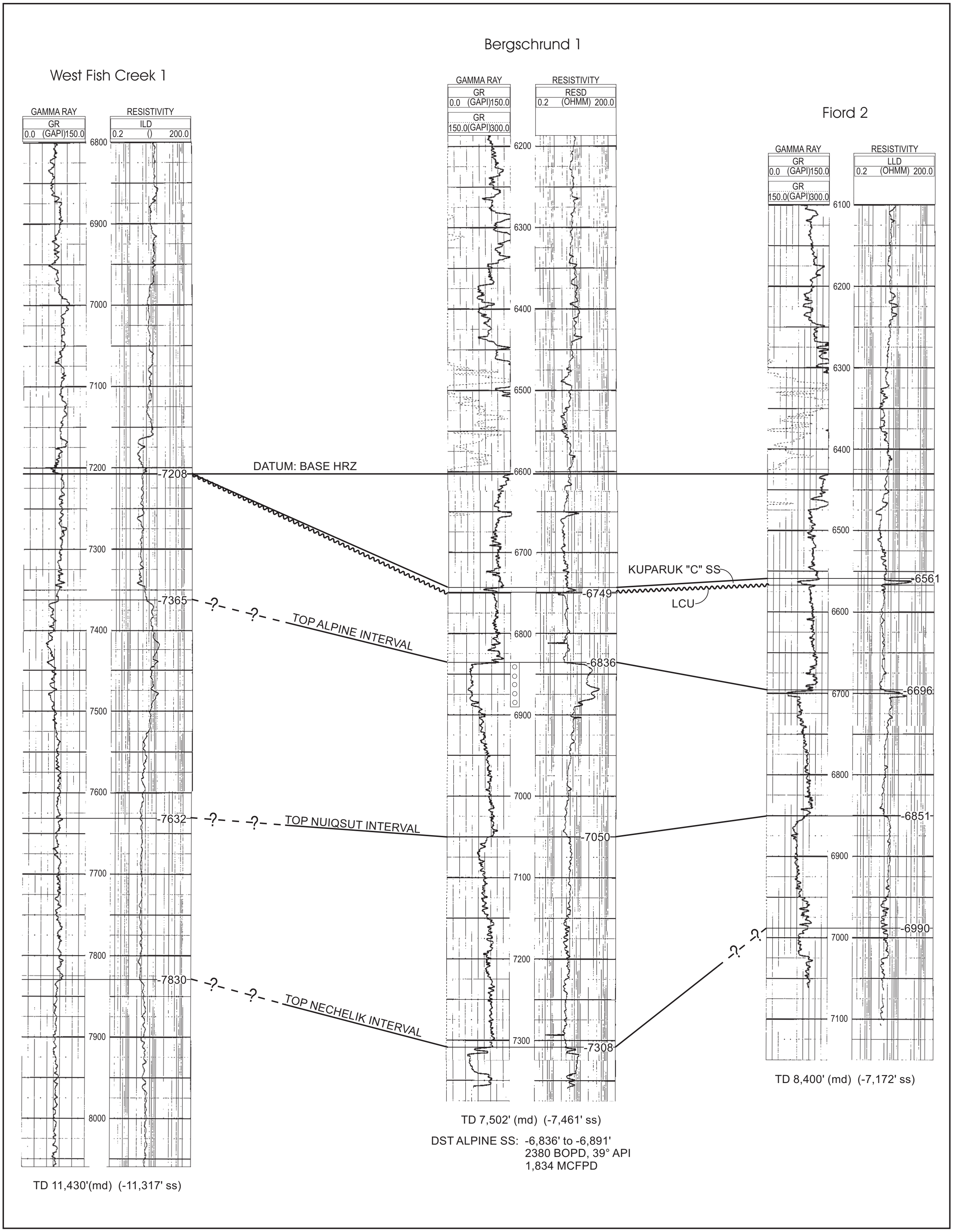


Figure 10. Cross Section A between West Fish Creek No. 1, Bergschrund No. 1 and Fiord No. 2 showing Late Jurassic through Hauterivian intervals, including the Alpine sandstone discovered in Bergschrund No. 1 and possible correlation of the interval into the NPRA. The location of Cross Section A is shown on Figure 9. LCU is the Lower Cretaceous unconformity.

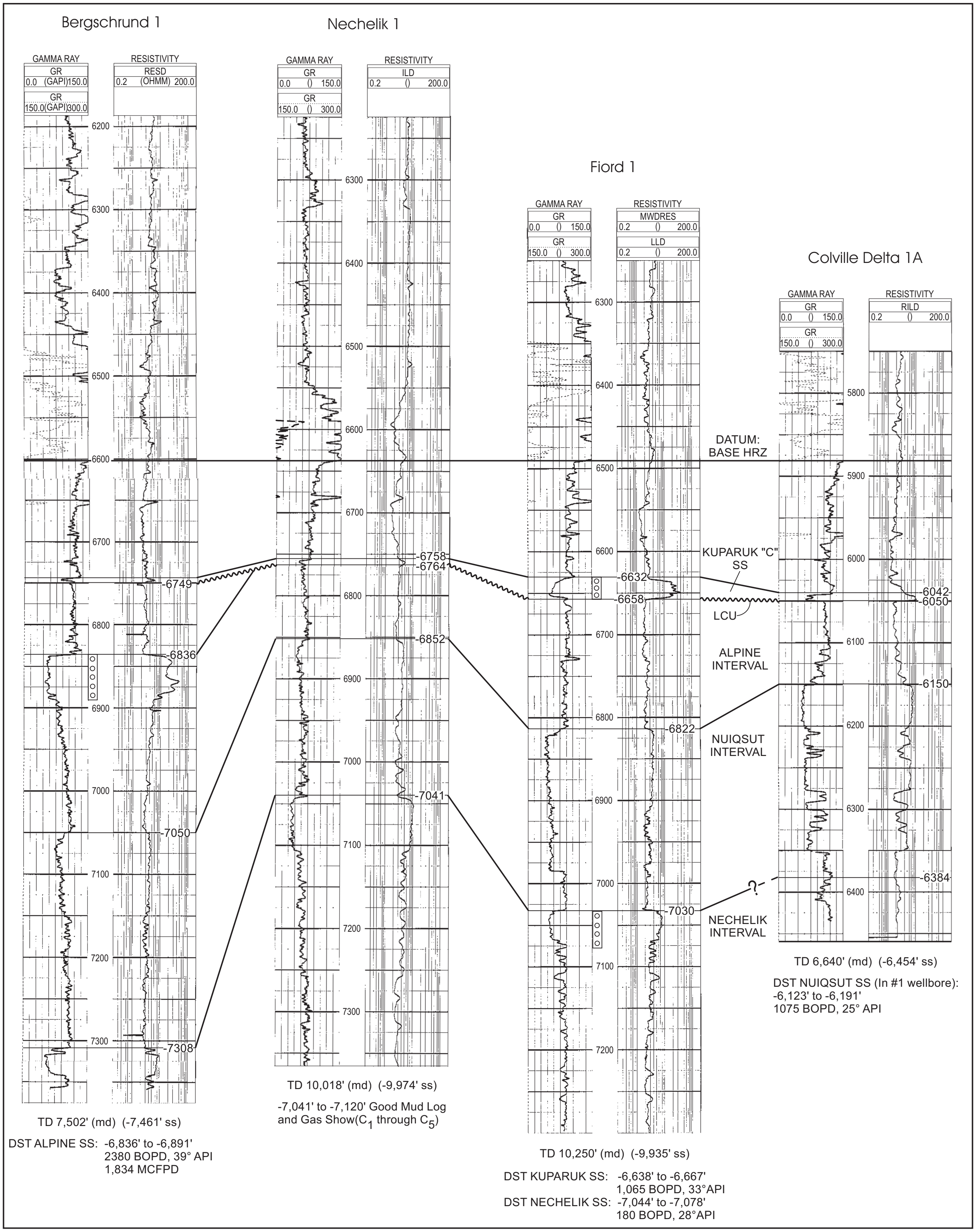


Figure 11. Cross Section B between Bergschrund No. 1, Nechelik No. 1, Fiord No. 1 and Colville Delta No. 1A, showing Late Jurassic through Hauterivian intervals, including the Alpine sandstone discovered in Bergschrund No. 1, the Kuparuk and Nechelik sandstones discovered in Fiord No. 1, and the Nuiqsut sandstone discovered in Colville Delta No. 1A. The location of Cross Section B is shown on Figure 9. LCU is the Lower Cretaceous unconformity.

Bergschrund No. 1 (Straight)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	6784	-6743	negl	0	0	tight	-	-	-	-
Alpine SS	6877	-6836	52	47	47	20	40	20	39	2380
Nuiqsut SS	7090	-7050	negl	0	0	tight	-	-	-	-
Nechelik SS	7349	-7308	25	18	18	12	0.23	40	?	-

Fiord No. 1 (Directional)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	6868	-6632	26	26	26	24	160	27	33	1065
Alpine SS	not prsnt	-	0	0	0	-	-	-	-	-
Nuiqsut SS	7074	-6822	negl	0	0	tight	-	-	-	-
Nechelik SS	7312	-7032	37	30	30	12	1.5	40	28	180

Colville Delta No. 1-A (Slightly Directional) (core data from 1-A wellbore, test rate from No. 1 wellbore)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	6169	-6042	negl	0	0	tight	-	-	-	-
Alpine SS	not prsnt	-	0	0	0	-	-	-	-	-
Nuiqsut SS	6290	-6150	152	95	95	12	1.0	40	25	1075
Nechelik SS	not prsnt	-	0	0	0	-	-	-	-	-

Nechelik No. 1 (Straight)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	6802	-6758	negl	0	0	tight	-	-	-	-
Alpine SS	not prsnt	-	0	0	0	-	-	-	-	-
Nuiqsut SS	not prsnt	-	0	0	0	-	-	-	-	-
Nechelik SS	7085	-7041	65	35	35	12	-	-	-	-

Fiord No. 2 (Directional)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	7774	-6561	negl	0	0	tight	-	-	-	-
Alpine SS	7914	-6696	6	6	6	20	-	-	-	-
Nuiqsut SS	8072	-6851	negl	0	0	tight	-	-	-	-
Nechelik SS	at TD ?	-	-	-	-	-	-	-	-	-

Kalubik No. 1 (Straight)

Reservoir Name	Top (md) (feet)	Top (ss) (feet)	Gross SS (feet)	Net SS (feet)	Net Pay (feet)	Porosity (%)	K (md)	Sw (%)	API (deg)	Rate (bopd)
Kuparuk SS	6080	-6047	43	35	30	20 - 25	50	40	26	1200
Alpine SS	not prsnt	-	-	-	-	-	-	-	-	-
Nuiqsut SS	6323	-6290	224	170	75	15	10	45	21	410
Nechelik SS	not prsnt	-	-	-	-	-	-	-	-	-

Table 5. Typical reservoir parameters of Early Cretaceous Hauterivian through Late Jurassic known reservoir sands in the Colville delta area. These data are summarized from publicly released information. Top (md) refers to measured depth and (ss) refers to subsea-level depths. Top not prsnt means 0 feet of Gross SS (sandstone) and is not meant to imply that the reservoir interval is not present. Gross SS less than 5 feet thick is signified by negl (negligible). Net SS is based on a 10 percent porosity cutoff. Net pay is oil saturated Net SS, and may not reflect producibility in the low permeability reservoirs. K and Sw (permeability and water saturation) are generalized where available, and not that useful in the lower permeability intervals.

Brief Discussion of the Stratigraphy and Sedimentology of Known Oil Reservoirs on the Colville High with Implications for Exploration

As has been described in the previous paragraphs, four significant oil-bearing sandstones have been encountered in the Colville delta area near the northeastern border of the NPRA. These are, from oldest to youngest, the Upper Jurassic Nechelik, Nuiqsut and Alpine sandstones, and the Lower Cretaceous (Hauterivian) Kuparuk Formation (informal C member).

The three Upper Jurassic sandstones appear to share many similarities in terms of overall depositional setting and lithologic characteristics. All are very fine to fine grained quartz arenites which contain a trace to 15 percent glauconite. They appear to have been deposited from an unknown northern source area which was probably removed in the early Cretaceous during the opening of the Canada Basin. All three sandstones were deposited on an inner shelf, probably as marine bars. Due to a general lack of publicly-available conventional core data and limited well control, a detailed interpretation of the depositional environments of these sandstones is not possible. However, core descriptions from the Nechelik sandstone in SOHIO Nechelik No. 1 indicate abundant burrowing and bioturbation, carbonaceous material, wavy bedding, asymmetrical ripple lamination, lenticular bedding and interlaminated mudstone. These sedimentary structures are consistent with, but not limited to, a lower shoreface depositional setting.

Log correlations and regional seismic correlations suggest that during the Late Jurassic, the Colville delta area was part of a broad, very low gradient marine shelf on a south facing passive margin. The shelf probably had limited accommodation space and relatively low rates of sedimentation. Over time, three successive Upper Jurassic intervals prograded farther south into the basin creating a slightly regressive depositional geometry. In the Colville delta area, this depositional and tectonic setting resulted in the deposition of the Nechelik, Nuiqsut, and Alpine nearshore sandstones in relatively close vertical and horizontal proximity; even though the sandstones record an approximate 20 million year time span. The deposition and preservation of these sandstones on the mud-rich shelf appears to have been controlled by a number of factors which include changes in relative and absolute sea level due to both eustatic and tectonic mechanisms, local topography created by normal faulting caused by pre-breakup rift related extensional tectonics, the location of point sources for sediments (river mouths and incised valleys), and localized erosion during sea level lowstands.

The Alpine interval appears to represent one of the last pulses of significant Jurassic sandstone deposition into the filled basin. Regional log correlations of the current public information suggest that the Alpine interval thins and probably onlaps on the Colville High (a structurally high feature related to the Barrow Arch located near the current Colville delta) north and east of Bergschrund No. 1. The immediately underlying Nuiqsut sandstone thickens to the northeast in the area of Colville Delta No. 1A. This may suggest movement on the Colville High following deposition of the Nuiqsut sandstone. Figure 10 shows the tentative correlations from the Colville delta area west to West Fish Creek No. 1 in the NPRA, and the thinning of the Alpine sand from Bergschrund No. 1 to the east in Fiord No. 2. In Figure 11, the Alpine sand at Bergschrund No. 1 is shown to be absent in Nechelik No. 1, and the thick Nuiqsut sand interval in Colville No. 1A thins and shales out west and south of that well. Regional NPRA seismic data also suggest (in areas along the Barrow Arch where the Alpine interval has not been eroded by the LCU) that localized movement on the Barrow Arch during deposition may have affected the accommodation space and interval thickness. Thus, the subcropping of LCU, coupled with the onlap onto the Barrow Arch that locally thickens, preserved sections, are two significant features of the Alpine interval.

The thin sandstone at the top of the Alpine interval in Fiord No. 2 (Figure 10) may be a transgressive lag overlying an Upper Jurassic unconformity. The thinning of the Alpine interval between Fiord No. 2 and Bergschrund No. 1 may be a result of truncation, not just onlap. With this interpretation, uplift possibly caused by movement of the Barrow Arch, resulted in uneven erosion of the original interval, preserving more of the section at Bergschrund No. 1 than at Fiord No. 2. A transgressive sand was then deposited, perhaps reworking locally exposed sands, and filling in any topographic lows. Therefore, the Alpine interval may be a complex of regressive and transgressive cycles that is difficult to differentiate, particularly given the limited amount of public well and seismic data.

The publicly-available seismic data from the NPRA and regional well penetrations show that the Alpine interval has some appealing characteristics from an oil and gas exploration point of view. It covers a large area along the south flank of the Barrow Arch generally from south of Smith Bay (west side of Teshekpuk Lake) in the NPRA to the eastern Kuparuk River Field area. Farther west, the Alpine interval thins considerably. The more proximal part of the interval can vary in thickness dramatically in places, sometimes displaying bi-directional downlap in very elongate mounds and showing erosion into steep channel walls. These characteristics may be indicative of tectonic events involving the Barrow Arch toward the end of the Late Jurassic.

In addition, the seismic amplitude of the top and basal reflectors vary laterally, which could be an avenue for seismic modeling. The publicly available seismic data in the NPRA is mostly 6- and 12-fold dynamite data (not migrated) acquired from 1974 to 1981 by Geophysical Service Inc. The data are generally of good quality and can be used as is for seismic sequence interpretation. However, modern processing would improve vertical resolution and coherence. The low fold or the offsets used may make the data inadequate for amplitude modeling.

The stratigraphy, lithology, and interpreted depositional environments of the C member of the Kuparuk Formation have been well documented in numerous published studies of the Kuparuk River oil field where the sandstone contains 40-60 percent of the field's two billion barrels of reserves. In the Kuparuk River Field, the sandstone is interpreted as a shallow marine transgressive sandstone which was deposited immediately on top of the regional LCU (Masterson and Paris, 1987). Its deposition and preservation appear to require the presence of syn-depositional normal faults related to the opening of the Canada Basin. Regional well correlations in the Colville delta area indicate that the development of more than 10 feet of reservoir quality Kuparuk sandstone is rare and limited in areal extent. However, Fiord No. 1 found 26 feet of good quality oil-saturated reservoir sandstone. Log character and the relative position of the sandstone with respect to the LCU in Fiord No. 1 suggests a similar depositional environment to that described for the Kuparuk River Field.

The Release of Additional Well Data in 1997

Beginning in fall 1997, data from a number of the more recent wells drilled on the Colville delta will become public. Information from wells drilled on state lands are usually held confidential for a period of 25 months after completion. If the data contain information significant to nearby unleased acreage, the period of confidentiality can be extended. This is the case for the ARCO Alpine Nos. 1, 1A and 1B. Data from those three wells will remain confidential until unleased acreage is offered in State Sale 86, scheduled for September 30, 1997. The data will be released approximately one month after that sale. Since much of the Colville delta drilling has occurred in the past two years, several wells remain in the initial 25-month confidentiality period. Appendices A, B and C (at the end of this report) list key wells, including completion dates, total depths, surface locations, formations at total depth, and the release dates for the well data.

Petroleum Potential of the Eastern NPRA Planning Area

The eastern NPRA planning area (Figure 2) includes portions of three of the four major structural provinces or trends which have historically been used to subdivide the NPRA. The northern one-third of the planning area (which contains the Beaufortian Rift and Cretaceous Rift trends) probably holds the greatest potential for commercial oil discoveries. The recent exploration success with the Upper Jurassic through Hauterivian reservoirs highlights the potential for new commercial discoveries in the Beaufortian Rift Trend. Recent leasing activity on adjoining state and native lands (Figure 3), and recent seismic data acquisition (Figure 7) indicate a high level of industry interest in the northern one-third of the planning area. This area also incorporates potential Cretaceous Brookian targets stratigraphically above the Beaufortian Rift Trend sequence. These secondary targets may help to reduce drilling risk in the northern one-third of the planning area by providing overlapping primary and secondary exploration prospects. Finally, the scheduled development of the Alpine Field and pipeline to the Kuparuk River Field, greatly improves exploration economics by lowering the minimum economic field size for prospects in the northern part of the planning area.

The key question regarding the Upper Jurassic through Hauterivian oil reservoirs encountered adjacent to the northeastern NPRA, are whether or not these types of trends can be successfully correlated into the NPRA and efficiently explored. If industry believes that similar reservoir intervals or older Jurassic intervals can be resolved seismically into prospects with potential reserves in the 75 to 400 million barrel range within the NPRA, renewed leasing should generate considerable interest within the Beaufortian Rift Trend.

Lower and Middle Jurassic sandstones have been found within the NPRA. These include the Simpson sandstone (not to be confused with the Simpson oil accumulation which occurs in a younger unit in the vicinity of Dease Inlet) and the Barrow sandstone which produces gas near Barrow (Figures 5 and 8). Based upon existing well control, these sandstones subcrop to the west of the NPRA planning area. Although it is beyond the scope of this paper to evaluate the potential of these older Jurassic sands, they do provide potential plays that warrant a closer look.

In order to better understand the relevance of Beaufortian sandstones to exploration in the NPRA, more detailed seismic interpretations, well analysis, correlation work, micropaleontologic work and geologic modeling will have to be completed. This work includes sequence stratigraphic analysis, detailed isopach mapping of select sequences, AVO (amplitude verses offset) and other seismic modeling, better biostratigraphic control and the development of more sophisticated regional geologic models. Although this paper has focused primarily on the Alpine interval because of its prominence in the recent Alpine Field discovery, other sand facies in the Early Jurassic through Hauterivian should not be overlooked in the Beaufortian Rift Trend in the NPRA.

In addition to the rift-related oil-bearing reservoirs which trend into the northern one-third of the planning area, it is probably useful to briefly discuss the potential of the middle and southern parts of the planning area. Interestingly, both the Cretaceous Brookian Trend and the Fold Belt Trend have been recently drilled outside of the eastern NPRA planning area on state and native lands east of the Colville River (six wells were drilled from 1989 through 1994). One well, ARCO Big Bend No. 1, was drilled on Native corporation lands south of Umiat in the Fold Belt Trend. The five other wells, BP Kuparuk Uplands (Ekvik) No. 1, BP Narvaq No. 1, BP Malguk No. 1, ARCO Tulaga No. 1 and UNOCAL Amethyst State No. 1, were drilled further to the north in the Cretaceous Brookian Trend. All of these wells have been plugged and abandoned as dry holes. The five more northerly wells were drilled primarily to evaluate a mix of several different targets, including the Kemik Sandstone (a regional Lower Cretaceous shelf sandstone equivalent in age to the C and D members of the Kuparuk Formation), Lower Cretaceous Torok Formation turbidites and Upper Cretaceous Colville Group lowstand deltas and associated delta front turbidites.

The post-LCU sequences are shallower to the west in the central part of the planning area (and eventually crop out), but these rocks could still provide drilling targets. The Upper Cretaceous section consists of the Seabee, Schrader Bluff and Prince Creek formations of the Colville Group. The Colville Group occupies the upper 2,000 to 4,500 feet of the sedimentary section over the area of the Cretaceous Brookian Trend in the middle part of the planning area. The sedimentary rocks of the Schrader Bluff and Prince Creek formations present in this area are dominantly shallow marine and non-marine sandstone, siltstone and shale which record the late filling of the Colville Trough. Structural dip within the Colville Group is gently to the east. In addition, an analysis of depositional sequences within the Colville Group indicate that the overall direction of progradation\basin fill was also dominantly from west to east. Although lacking significant hydrocarbons in nearby wells east of the middle part of the planning area, the Upper Cretaceous sandstones can exhibit excellent reservoir qualities. For example, at approximately 4,800 feet depth, the Kuparuk Uplands (Ekvik) No. 1, penetrated thick Schrader Bluff Formation sandstones with porosities which exceed 20 percent and permeabilities ranging to over 500 millidarcies. These sandstones were probably deposited as shallow marine delta front sandstones associated with a large lowstand delta complex.

The NPRA seismic data poorly resolves Upper Cretaceous rocks because of the shallow depth and the low fold multiplicity of the data. It would be difficult to perform reliable sequence interpretation with these data, but a gross structural interpretation is feasible. Unfortunately, because of the lack of obvious structures, the best chance for developing prospects in this section probably involves searching for potential stratigraphic traps interpreted from the seismic data.

The Lower Cretaceous section consists of, from older to younger, the upper Kingak Formation, Kemik Sandstone, Pebble Shale, Hue Shale, Torok Formation and the Nanushuk Group. In the middle part of the planning area, the Torok Formation, due to the potential for the development of sand-rich submarine fan complexes, probably is the best exploration target. Within the middle of the planning area, Torok Formation base-of-slope turbidites should be present within the oil window (Gryc, 1988). Therefore, since potential reservoirs are likely to be encased in mature marine shales, petroleum source, migration, and trapping mechanism should not be problematic. The biggest concern with targeting this play is the relatively low probability of finding high quality reservoir sands in sufficient volumes (porosity, thickness, and areal extent) to be commercially viable. The publicly-available seismic data are of reasonably good quality in the Torok Formation interval and provide a worthwhile reconnaissance tool for this play. The sands at these depths should have sonic velocities slightly higher than the surrounding shales and very sandy intervals may be readily visible on the seismic data. In the middle part of the planning area, the older Early Cretaceous units are likely to be quite distal, with only a minor chance for reservoir sand development.

The fact that industry has expended tens of millions of dollars to explore the Cretaceous Brookian Trend outside the NPRA is encouraging insofar as the overall prospectiveness and future lease acquisition. However, there is significant downside risk for prospects developed in the middle part of the planning area. First, the wells that drilled into this trend so far have failed to find commercial deposits. Sandstones within the Torok Formation, Nanushuk and Colville groups are litharenites which typically contain abundant ductile grains, that reduce the chance for preserved porosity and permeability at depth. However, it is important to note that under the right conditions (as evidenced in the BP Kuparuk Uplands (Ekvik) No. 1, either through the development of secondary porosity or the preservation of primary porosity), litharenites of the Colville Group can have excellent reservoir properties at depth. Unlike the Colville delta area, it is unclear whether or not a viable oil generating petroleum system is present given the generally gas-prone geochemistry of Torok shales (Gryc, 1988) and the lack of known oil migration pathways. Additionally, the Cretaceous Brookian Trend lacks large structures and fault systems, requiring prospects to rely on stratigraphic discontinuities and regional dip for trapping mechanisms.

The Fold Belt Trend contains known gas accumulations and an oil accumulation at Umiat (description in previous section). This trend contains structures of varying complexity, however, the Brookian sandstones that are present within these structures are immature litharenites which generally exhibit poor reservoir properties, particularly low porosity. Geologic reconstructions and thermal maturity data from the Fold Belt Trend indicates that these sandstones were buried to significant depths in the Colville Trough during the Late Cretaceous and Paleogene (Cole and others, 1995). Additionally a viable oil source and charging system is still somewhat problematic. Industry wells drilled within this trend to the east of the NPRA have not been successful. However, the area does contain large faults that may provide migration pathways for oil to move into structures, as is evidenced at Umiat. This trend occupies a relatively small portion of the planning area, but the known oil at Umiat and presence of mappable structures may help to encourage further exploration.

In conclusion, the authors believe that the NPRA planning area holds significant potential for new commercial oil accumulations. The northern area -- the Beaufortian Rift Trend -- in particular appears to exhibit moderate to high potential for containing commercial oil accumulations in stratigraphic traps. The eastern NPRA's petroleum potential has not been comprehensively evaluated since the USGS completed its program in 1982. Clearly, the discoveries in the Colville delta area indicate that the eastern NPRA needs to be re-evaluated using modern exploration methods and technology.

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Selected References

Ahlbrandt, T.S., ed., 1979, Preliminary geologic, petrologic, and paleonotlogic results of the study of Nanushuk Group rocks, North Slope, Alaska: U.S. Geological Survey Circular 794, 163 p.

Alaska Geological Society, 1971, West to east stratigraphic correlation section, Point Barrow to Ignek Valley, Arctic North Slope, Alaska: Anchorage, Alaska Geological Society.

Alaska Geological Society, 1972, Northwest to southeast stratigraphic correlation section, Prudhoe Bay to Ignek Valley, Arctic North Slope, Alaska: Anchorage, Alaska Geological Society.

Alaska Geological Society, 1977, North to south stratigraphic correlation section, Beaufort Sea--Prudhoe Bay--Nora No. 1, Arctic Slope, Alaska: Anchorage, Alaska Geological Society.

Bird, K.J., 1988, The geologic basis for appraising undiscovered hydrocarbon resources in the NPRA, in George Gryc, ed., Geology and exploration of the National Petroleum Reserve in Alaska, 1974 to 1982: U.S. Geological Survey Professional Paper 1399, p. 81-116.

Carter, R.D., Mull, C.G., Bird, K.J., and Powers, R.B., 1977, The petroleum geology and hydrocarbon potential of Naval Petroleum Reserve No. 4, North Slope, Alaska: U.S. Geological Survey Open-File Report 77-475, 61 p.

Cole, F., Bird, K.J., Toro, J., Roure, F., and Howell, D.G., 1995, Kinematic and subsidence modeling of the north-central Brooks Range and North Slope, Alaska, : U.S. Geological Survey Open-File Report 95-823, 3 sheets.

Gryc, George, ed., 1988, Geology and exploration of the National Petroleum Reserve in Alaska, 1974 to 1982: U.S. Geological Survey Professional Paper 1399, 940 p., 58 plates.

Hubbard, R.J., Edrich, S.P., Rattey, R.P., 1987, Geological evolution and hydrocarbon habitat of the "Arctic Alaska Microplate", in Tailleur, I.L., and Weimer, P., eds., Alaskan North Slope Geology: Pacific Section Society of Economic Paleontologists and Mineralogists, vol. 2, p. 797-830.

Haga, H., and Mickey, M.B., 1983, Barrow area Neocomian biostratigraphy: prepared under contract to U.S. Geological Survey, v. 1, 12 p., v. 2, 36 p. [Available from National Oceanographic and Atmospheric Administration (E.D.S.), Mail Code D621, Boulder, CO 80303] .

Huffman, A.C., Jr., ed., 1985, Geology of the Nanushuk Group and related rocks, North Slope, Alaska: U.S. Geological Survey Bulletin 1614, 129 p.

Kirschner, C.E., and Rycerski, B.A., 1988, Petroleum Potential of representative stratigraphic and structural elements in the National Petroleum Reserve in Alaska, in George Gryc, ed., Geology and exploration of the National Petroleum Reserve in Alaska, 1974 to 1982: U.S. Geological Survey Professional Paper 1399, p.191-208.

Magoon, L.B. III, 1994, Petroleum resources in Alaska, in G. Plafker, and H.C. Berg, eds., The Geology of Alaska: Geological Society of America, The Geology of North America, vol. G-1, p. 905-936.

Masterson, W.D. and Paris, C.E., 1987, Depositional history and reservoir description of the Kuparuk River Formation, North Slope, Alaska, , in Tailleur, I.L., and Weimer, P., eds., Alaskan North Slope Geology: Pacific Section Society of Economic Paleontologists and Mineralogists, vol. 1, p. 95-107.

Mickey, M.B., and Haga, H., 1987, Jurassic-Neocomian biostratigraphy, North Slope, Alaska, in Tailleur, I.L., and Weimer, P., eds., Alaskan North Slope Geology: Pacific Section Society of Economic Paleontologists and Mineralogists, vol. 1, p. 397-404.

Mickey, M.B., and Haga, H., and Mull, C.G., 1995, Paleontologic data: Tingmerkpuk Sandstone and related units, northwestern DeLong Mountains, Brooks Range, Alaska: Alaska Division of Geological and Geophysical Surveys Public-data file report 95-31, 42 p.

Miller, D.J., Payne, T.G., and Gryc, G., 1959, Geology of possible petroleum provinces in Alaska: U.S. Geological Survey Bulletin 1094, 131 p.

Moore, T.E., Wallace, W.K., Bird, K.J., Karl, S.M., Mull, C.G., and Dillon, J.T., 1994, The geology of northern Alaska, in Plafker, G, and Berg, H.C., eds., The Geology of Alaska: The Geological Society of America, The Geology of North America, vol. G-1, p. 49-140.

Mull, C.G., 1985, Cretaceous tectonics, depositional cycles and the Nanushuk Group, Brooks Range and Arctic Slope, Alaska, in A.C. Huffman ed., Geology of the Nanushuk Group and related rocks, North Slope, Alaska, U.S. Geol. Surv. Bull. 1614, p. 7-36.

Mull, C.G., 1995, Preliminary evaluation of the hydrocarbon source rock potential of the Tingmerkpuk Sandstone (Neocomian) and related rocks, northwestern DeLong Mountains, Brooks Range, Alaska: Alaska Division of Geological and Geophysical Surveys Public-data file report 95-30, 20 p.

Mull, C.G., Roeder, D.H., Tailleur, I.L., Pessel, G.H., Grantz, A., and May, S.D., 1987, Geologic sections and maps across Brooks Range and Arctic Slope to Beaufort Sea: Geol. Soc. Am. Map and Chart Series, MC-28S.

Mull, C.G., 1989, Generalized geologic map and cross section, Brooks Range and Arctic Slope, in C.G. Mull and K.E. Adams eds., Dalton Highway, Yukon River to Prudhoe Bay, Alaska: Bedrock Geology of the Eastern Koyukuk Basin, Central Brooks Range, and Eastern Arctic Slope, Guidebook 7, Alaska Division of Geological and Geophysical Surveys, 1 sheet.

Reid, J.C., 1958, Exploration of Naval Petroleum Reserve No. 4 and adjacent areas, northern Alaska, 1944-53, part 1, History of the exploration: U.S. Geological Survey Professional Paper 301, 192 p.

Schindler, J.F., 1988, History of exploration in the National Petroleum Reserve in Alaska, with emphasis on the period from 1975 to 1982, in George Gryc, ed., Geology and exploration of the National Petroleum Reserve in Alaska, 1974 to 1982: U.S. Geological Survey Professional Paper 1399, p. 13-72.

Thomas, C.P., Allaire, R.B., Doughty, T.C., Faulder, D.D., Irving, F.S., Jamison, H.C., and White, G.J., 1993, Analysis of five undeveloped fields: U.S. Department of Energy, Alaska North Slope National Energy Strategy Initiative, report prepared under contract no. DE-AC07-76ID01570, 317 p.

U.S., Department of Commerce, National Oceanic and Atmospheric Administration, 1986, Catalog of geological and geophysical data for the National Petroleum Reserve in Alaska: NOAA Key to Geophysical Records Documentation No. 16 (revised edition), 108 p.

U.S. Department of the Interior, 1980, Interior updates Alaska petroleum reserve data: Office of the Secretary, News Release, July 17, 1980, 3 p.

U.S. Department of the Interior, Office of Minerals Policy and Research Analysis, 1979, Final report of the 105(b) economic and policy analysis; Alternative overall procedures for the exploration, development, production, transportation and distribution of the petroleum resources of the National Petroleum Reserve In Alaska (NPRA): Washington, D.C., U.S. Government Printing Office, 145 p.

Appendix A

Exploration wells on the Colville delta and generally east of the NPRA. This listing includes exploration wells (by completion date) drilled on the Colville delta and in the area east of the NPRA eastern border (generally between the eastern border and about longitude 150 W). Release dates for the well data are approximate. R means already released and cnf indf means confidential indefinitely. Reproducible paper and sepia copies of well logs and completion reports for most wells drilled on state lands after 1959, can be viewed at or copied from the well log library at the Alaska Oil and Gas Conservation Commission (AOGCC), 3001 Porcupine Drive, Anchorage, Alaska 99501. AOGCC also maintains digital log data for recent wells. Viewing access to this well data is free of charge. Copies are available for a fee and large reproduction orders may need to be handled off site by a third party vendor. AOGCC's files may not contain data for wells drilled prior to 1959. For those wells, the data may be obtained from the USGS National Energy Research Seismic Library, P.O. Box 25046, MS-960, Denver, Colorado 80225-0046.

#	API Num PI	Well Name	No.	Operator	Spud	Completion	Fm. @ TD	TD	Lat-Surf	Lon-Surf	Release
1	50103202310000	NEVE	1	ARCO	02/10/1996	04/23/1996	confidential	7700	70.31352	151.05150	05/23/1998
2	50103202330101	TEMPTATION	1A	ARCO	04/01/1996	04/23/1996	confidential	8950	70.39207	151.15310	05/23/1998
3	50103202320101	BERGSCHRUND	2A	ARCO	03/01/1996	04/17/1996	confidential	7896	70.32658	150.89190	05/17/1998
4	50103202330000	TEMPTATION	1	ARCO	03/15/1996	04/04/1996	confidential	7750	70.39207	151.15310	05/04/1998
5	50103202380000	NANUK	1	ARCO	03/10/1996	03/24/1996	confidential	7630	70.29312	150.97910	04/24/1998
6	50103202110202	ALPINE	1B	ARCO	03/01/1995	03/23/1996	confidential	8850	70.33321	151.01030	10/29/1997
7	50103202340000	ALPINE	3	ARCO	02/10/1996	03/11/1996	confidential	7649	70.36663	151.01150	04/11/1998
8	50103202320000	BERGSCHRUND	2	ARCO	02/09/1996	02/27/1996	confidential	8600	70.32658	150.89190	03/27/1998
9	50103202100101	FIORD	3A	ARCO	04/08/1995	04/15/1995	confidential	9147	70.36901	150.74270	05/15/1997
10	50103202100000	FIORD	3	ARCO	03/21/1995	04/04/1995	confidential	7030	70.36901	150.74270	05/04/1997
11	50103202110101	ALPINE	1A	ARCO	02/20/1995	03/01/1995	confidential	9940	70.33321	151.01030	10/29/1997
12	50103202110000	ALPINE	1	ARCO	01/23/1995	02/16/1995	confidential	7500	70.33321	151.01030	10/30/1997
13	50103202070000	BERGSCHRUND	1	ARCO	03/15/1994	04/14/1994	Kingak Shale	7502	70.35224	150.91630	R
14	50287200130000	AMETHYST ST.	1	UNOCAL	02/02/1994	03/17/1994	Torok Fm	11136	69.54321	150.31010	R
15	50103202010000	FIORD	2	ARCO	02/15/1994	03/07/1994	Kingak Shale	8400	70.38110	150.76410	R
16	50103201870000	KUUKPIK	3	ARCO	02/17/1993	04/14/1993	Kingak Shale	6880	70.46114	150.56710	R
17	50103201880000	COLVILLE RIV	1	ARCO	03/16/1993	04/07/1993	Kuparuk Fm	7300	70.31139	150.65420	R
18	50287200120000	TULAGA	1	ARCO	02/07/1993	03/25/1993	Miluveach Fm	11742	69.70390	151.07580	R
19	50103201890000	TILL	1	ARCO	02/27/1993	03/18/1993	Kuparuk Fm	6975	70.40189	150.58760	R
20	50287200110000	BIG BEND	1	ARCO	01/05/1993	03/14/1993	Fortress Mtn Fm	10737	69.16187	152.26660	R
21	50103201650000	KALUBIK	1	ARCO	03/05/1992	05/01/1992	Kingak Shale	8303	70.49397	150.27500	R
22	50103201670000	CIRQUE	2	ARCO	03/17/1992	04/25/1992	Kuparuk Fm	7660	70.12796	150.41330	R
23	50103201620000	FIORD	1	ARCO	02/04/1992	04/18/1992	Lisburne Gp	10250	70.41720	150.81450	R
24	50103201630000	TARN	1	ARCO	01/21/1992	03/23/1992	Kuparuk Fm	6709	70.18333	150.39830	R
25	50223200190000	MALGUK	1	BP	03/13/1991	04/19/1991	Kingak Shale	11375	69.66995	149.91870	R
26	50287200100000	NARVAQ	1	BP	01/19/1991	02/18/1991	Kingak Shale	9200	69.96361	150.11300	R
27	50103201490000	KRU (BERMUDA)	36-10-7	ARCO	01/21/1991	02/02/1991	Kuparuk Fm	6750	70.18097	150.26090	R
28	50103201040000	RUBY STATE	1	UNOCAL	03/07/1989	03/20/1989	Schrader Bluff	3850	70.05462	150.05580	R
29	50287200090000	KUPARUK UP.	Ekvik 1	BP	02/21/1989	03/16/1989	Seabee Fm	6100	69.78975	150.43250	R
30	50287200080000	WOLFBUTTON	32-7-8	TEXACO	01/15/1989	02/16/1989	Kingak Shale	9550	69.92287	150.19070	R
31	50223200170000	WOLFBUTTON	25-6-9	TEXACO	01/09/1989	02/12/1989	Kingak Shale	10241	69.84299	149.75960	R
32	50103200480000	COLVILLE DELTA	3	TEXACO	02/14/1986	03/31/1986	Kingak Shale	6800	70.43732	150.32940	R
33	50103200470000	COLVILLE DELTA	2	TEXACO	01/23/1986	03/16/1986	Kingak Shale	6800	70.47195	150.26780	R
34	50103200540000	COLV DEL 251306	1	AMERADA	01/17/1986	03/04/1986	Kingak Shale	6871	70.44514	150.45950	R
35	50103200380101	COLVILLE DELTA	1A	TEXACO	04/07/1985	04/26/1985	Kuparuk Fm	6640	70.47627	150.39650	R
36	50103200380000	COLVILLE DELTA	1	TEXACO	01/29/1985	04/07/1985	Endicott Gp	9457	70.47627	150.39650	R
37	50029208880000	RAVIK STATE	1	ARCO	01/25/1983	04/03/1983	Kingak Shale	8200	70.09596	149.90750	R
38	50103200200000	NECHELIK	1	SOHIO	01/17/1982	03/17/1982	Lisburne Gp	10018	70.39330	150.97970	R
39	50137200040000	KILLIK	1	CHEVRON	04/22/1981	12/05/1981	confidential	12492	68.42300	154.30710	cnf indf
40	50057200010000	TULUGAK	1	TEXACO	05/15/1977	12/31/1977	Miluveach Fm	16457	68.98481	151.32980	R
41	50137200020000	E KURUPA U	1	TEXACO	12/09/1975	05/01/1976	Fortress Mtn Fm	12695	68.84651	153.31790	R
42	50137200010000	W KURUPA UNIT	1	TEXACO	12/06/1975	04/14/1976	Fortress Mtn Fm	11060	68.88295	155.25490	R
43	50103200030000	ITKILLIK RIV U	1	ARCO	02/15/1972	07/23/1972	Basement	15321	70.06593	150.85310	R
44	50287200040000	COLVILLE	2	MCCULLOCH	11/28/1971	12/25/1971	Torok Fm	3254	69.36526	151.83360	R
45	50103200020000	COLVILLE DEL ST	1	GULF	02/16/1970	04/22/1970	Lisburne Gp	9299	70.49477	150.58700	R
46	50029200510000	TOOLIK	3	ARCO	01/28/1970	03/15/1970	Tertiary System	6020	70.07643	149.91460	R
47	50287200030000	COLVILLE U	1	MCCULLOCH	01/26/1970	03/11/1970	Tuktu Fm	4150	69.33747	151.91260	R
48	50287200010000	E KUPARUK	1	TEXACO	03/30/1969	07/06/1969	Grandstand Fm	7000	69.28781	150.15640	R
49	50103100030000	KOOKPUK	1	UNOCAL	12/21/1966	03/10/1967	Basement	10193	70.29313	150.47550	R
50	50287100150001	GUBIK	1	COLORADO	09/01/1966	09/13/1966	Nanushuk Gp	4406	69.42763	151.40770	R
51	50103100020000	COLVILLE	1	SINCLAIR	11/12/1965	03/08/1966	Basement	9930	70.36063	150.26520	R
52	50287100200000	ITKILLIK UNIT	1	BP	01/09/1965	03/22/1965	Torok Fm	7751	69.45548	150.57560	R
53	50287100180000	KUPARUK	1	BP	05/01/1964	11/24/1964	Torok Fm	6570	69.29716	150.83050	R
54	50287100220000	LITTLE TWIST U	1	SINCLAIR	05/12/1964	06/07/1964	Torok Fm	3625	69.14072	152.81850	R
55	50287100210000	SCHRADER UNIT	1	SINCLAIR	03/18/1964	04/24/1964	Torok Fm	5129	69.17703	151.01030	R
56	50287100160000	E UMIAT	1	BP	01/13/1964	03/28/1964	Nanushuk Gp	3347	69.34485	151.74500	R
57	50287100170000	SHALE WALL	1	BP	01/15/1964	03/07/1964	Nanushuk Gp	4026	69.03240	150.86360	R
58	50287100150000	GUBIK UNIT	1	COLORADO	07/16/1963	11/12/1963	Nanushuk Gp	4406	69.42763	151.40770	R

Appendix B

Exploration wells within the NPRA, including OCS wells and two western Alaska wells. This listing includes exploration wells (by completion date) drilled within the NPRA, OCS wells drilled offshore to the north, and Eagle Creek No. 1 and Tungak No. 1 located west of the NPRA. *Livehorse No. 1 is confidential indefinitely; all other well data in this table are released. Data from wells drilled inside the NPRA before 1982 are available from the USGS National Energy Research Seismic Library, P.O. Box 25046, MS-960, Denver, Colorado 80225-0046. Data from federal Offshore Continental Shelf (OCS) wells in Alaska are available from the Minerals Management Service, 949 East 36th Ave, Anchorage, AK 99508-4302. All other data are available from the AOGCC (see Appendix A for address).

#	API Num PI	Well Name	No.	Operator	Spud	Completion	Fm. @ TD	TD	Lat-Surf	Lon-Surf
1	55232000030000	OCS 0267(FIREWEED)	1	ARCO	10/19/1990	12/25/1990	Neruokpuk Fm	9650	71.08798	152.60320
2	55231000040000	OCS 0302(MARS)	1	AMOCO	03/12/1986	04/27/1986	Neruokpuk Fm	7982	70.84309	152.07180
3	55231000030000	OCS 0804(ORION)	1	EXXON	11/10/1985	12/15/1985	Neruokpuk Fm	7300	70.95618	152.06290
4	55232000020000	OCS 0280(ANTARES)	2	EXXON	01/19/1985	04/12/1985	Neruokpuk Fm	11608	71.03597	152.72380
5	50163200040000	BRONTOSAURUS	1	ARCO	01/24/1985	03/27/1985	Neruokpuk Fm	6660	70.90901	157.24590
6	55232000010000	OCS 0280(ANTARES)	1	EXXON	11/01/1984	01/18/1985	Neruokpuk Fm	8450	71.03598	152.72370
7	50103200210000	LIVEHORSE *	1	CHEVRON	01/12/1982	05/04/1982	confidential	12312	70.83220	152.30330
8	50207200020000	TUNGAK CREEK	1	UNOCAL	12/11/1981	03/13/1982	Torok Fm	8212	69.88390	162.27320
9	50119200010000	KOLUKTAK	1	USGS	03/23/1981	04/19/1981	Torok Fm	5882	69.75239	154.61110
10	50103200170000	NORTH INIGOK	1	USGS	02/12/1981	04/04/1981	Shublik Fm	10170	70.25759	152.76600
11	50163200030000	KUYANAK	1	USGS	02/13/1981	03/31/1981	Neruokpuk Fm	6690	70.93152	156.03780
12	50023200180000	TULAGEAK	1	USGS	02/26/1981	03/23/1981	Basement	4015	71.18945	155.73360
13	50023200190000	WALAKPA	2	USGS	01/03/1981	02/15/1981	Basement	4360	71.05000	156.95280
14	50137200030000	LISBURNE	1	USGS	06/11/1979	06/02/1980	Lisburne Gp	17000	68.48485	155.69320
15	50155200010000	AWUNA	1	USGS	02/29/1980	04/20/1980	Fortress Mtn Fm	11200	69.15321	158.02200
16	50287200070000	SEABEE	1	USGS	07/01/1979	04/15/1980	Kingak Shale	15611	69.38015	152.17530
17	50023200140000	W DEASE	1	USGS	02/19/1980	03/26/1980	Basement	4170	71.15907	155.62920
18	50279200070000	E SIMPSON	2	USGS	01/29/1980	03/16/1980	Basement	7505	70.97861	154.67390
19	50279200040000	IKPIKPUK	1	HUSKY	11/28/1979	02/28/1980	Basement	15481	70.45547	154.33130
20	50301200010000	TUNALIK	1	USGS	11/10/1978	01/01/1980	Lisburne Gp	20335	70.20596	161.06920
21	50279200060000	J W DALTON	1	USGS	05/07/1979	08/02/1979	Basement	9367	70.92049	153.13750
22	50279200030000	INIGOK	1	HUSKY	06/07/1978	05/20/1979	Kekiktuk Congl	20102	70.00486	153.09910
23	50301200020000	PEARD	1	USGS	01/26/1979	04/13/1979	Basement	10225	70.71564	159.00070
24	50279200050000	E SIMPSON	1	USGS	02/19/1979	04/10/1979	Basement	7739	70.91779	154.61840
25	50023200130000	WALAKPA	1	USGS	12/25/1979	02/07/1979	Basement	3666	71.09934	156.88430
26	50163200010000	S MEADE	1	USGS	02/07/1978	01/22/1979	Basement	9945	70.61497	156.88390
27	50073200010000	EAGLE CK	1	CHEVRON	02/25/1978	12/01/1978	L Cretaceous Series	12049	68.71688	162.54930
28	50163200020000	KUGRUA	1	HUSKY	02/12/1978	05/28/1978	Lisburne Gp	12588	70.58702	158.66190
29	50103200110000	N KALIKPIK	1	USGS	02/27/1978	04/14/1978	Kingak Shale	7395	70.50917	152.36780
30	50279200020000	DREW POINT	1	HUSKY	01/13/1978	03/13/1978	Basement	7946	70.87976	153.90000
31	50279200010000	S SIMPSON/NPR-4	1	HUSKY	03/09/1977	04/30/1977	Basement	8795	70.80688	154.98180
32	50103200090000	W FISH CK	1	HUSKY	02/14/1977	04/27/1977	Kekiktuk Congl	11427	70.32666	152.06050
33	50103200100000	W T FORAN	1	HUSKY	03/07/1977	04/24/1977	Basement	8864	70.83223	152.30310
34	50103200080000	ATIGARU PT	1	HUSKY	01/12/1977	03/15/1977	Basement	11535	70.55612	151.71650
35	50103200070000	S HARRISON BAY	1	HUSKY	11/21/1976	02/08/1977	Wahoo Limestone	11290	70.42481	151.73280
36	50103200060000	E TESHEKPUK	1	HUSKY	03/13/1976	05/16/1976	Basement	10664	70.56992	152.94350
37	50103200040000	CAPE HALKETT	1	U S NAVY	03/24/1975	05/22/1975	Basement	9900	70.76740	152.46660
38	50119100100000	WOLF CREEK	3	U S NAVY	08/20/1952	11/03/1952	Torok Fm	3760	69.38639	153.52360
39	50287100110000	UMIAT	11	U S NAVY	06/03/1952	08/29/1952	Torok Fm	3303	69.40722	152.09720
40	50119100070000	SQUARE LAKE	1	U S NAVY	01/26/1952	04/18/1952	Torok Fm	3987	69.56667	153.30000
41	50297100010000	KAOLAK	1	U S NAVY	07/21/1951	11/13/1951	Torok Fm	6952	69.93333	160.24750
42	50279100330000	TOPAGORUK	1	U S NAVY	06/15/1950	09/28/1951	M Devonian Series	10503	70.62500	155.89330
43	50119100110000	TITALUK	1	U S NAVY	04/22/1951	07/06/1951	Torok Fm	4020	69.42250	154.56780
44	50279100340000	E TOPAGORUK	1	U S NAVY	02/18/1951	04/16/1951	Torok Fm	3589	70.57722	155.37750
45	50119100060000	E OUMALIK	1	U S NAVY	10/23/1950	01/07/1951	Torok Fm	6035	69.79139	155.54420
46	50163100020000	MEADE	1	U S NAVY	05/02/1950	08/21/1950	Nanushuk Gp	5305	70.04166	157.48970
47	50023100040000	NORTH SIMPSON	1	U S NAVY	05/06/1950	06/03/1950	Torok Fm	3774	71.05639	154.96830
48	50119100050000	OUMALIK	1	U S NAVY	06/11/1949	04/23/1950	Kingak Shale	11872	69.83833	155.99000
49	50103100010000	FISH CK	1	U S NAVY	05/17/1949	09/04/1949	Torok Fm	7020	70.31194	151.87220
50	50279100320000	SIMPSON WELL	1	U S NAVY	06/14/1947	06/09/1948	Basement	7002	70.95333	155.36440
51	50287100020000	UMIAT	2	U S NAVY	06/25/1947	12/12/1947	Torok Fm	6212	69.38333	152.08110
52	50287100010000	UMIAT	1	U S NAVY	06/22/1945	10/05/1946	Torok Fm	6005	69.39667	152.32750
53	50057100010000	GRANDSTAND	1	U S NAVY	05/01/1952	08/08/1952	Torok Fm	3939	68.96611	151.91720
54	50287100140000	GUBIK TEST	2	U S NAVY	09/10/1951	12/14/1951	Nanushuk Gp.	4620	69.42763	151.44870
55	50287100130000	GUBIK TEST	1	U S NAVY	05/20/1951	08/11/1951	Torok Fm	6000	69.43389	151.47580

Appendix C

Shallow exploration wells and core holes. This listing includes shallow (<3,000 feet md) exploration wells/core holes (by completion date) drilled within the NPRA, and Cirque 1, 1X and East Umiat No. 1 located east of the NPRA. All well data in this table are released. Data on wells drilled by the U.S. Navy are available from the USGS. Other wells are available from the AOGCC (see previous appendices for addresses).

#	API Num PI	Well Name	No.	Operator	Spud	Completion	Fm. @ TD	TD	Lat-Surf	Lon-Surf
1	50103201660000	CIRQUE *	1X	ARCO	02/22/1992	04/13/1992	Sagav/Colv Undf	2709	70.12723	150.40850
2	50023200350000	WALAKPA	10	N S B	03/25/1992	04/09/1992	Kingak Shale	2379	71.07604	157.00120
3	50023200320000	WALAKPA	7	N S B	03/11/1992	04/09/1992	Kingak Shale	2425	71.07578	157.04460
4	50023200340000	WALAKPA	9	N S B	02/27/1992	04/05/1992	Kingak Shale	2530	71.06191	157.00350
5	50023200330000	WALAKPA	8	N S B	02/06/1992	04/03/1992	Kingak Shale	2474	71.06139	157.04560
6	50103201640000	CIRQUE	1	ARCO	02/11/1992	03/16/1992	Sagav/Colv Undf	2415	70.12450	150.40850
7	50023200280000	WALAKPA	3	N S B	02/02/1991	04/21/1991	Kingak Shale	2574	71.06490	156.95870
8	50023200300000	WALAKPA	5	N S B	03/23/1991	04/08/1991	Kingak Shale	2270	71.07930	156.91260
9	50023200290000	WALAKPA	4	N S B	02/25/1991	04/06/1991	Kingak Shale	2300	71.08046	156.96250
10	50023200310000	WALAKPA	6	N S B	03/10/1991	04/04/1991	Kingak Shale	2570	71.06216	156.87490
11	50023200220000	S BARROW	NSB-3	N S B	05/04/1987	05/14/1987	Jurassic System	2424	71.17085	156.53920
12	50023200070000	IKO	1	U S NAVY	02/01/1975	03/11/1975	Shublik Fm	2731	71.17085	156.16790
13	50287200020000	E UMIAT	2	MCCULLOCH	04/05/1969	05/21/1969	Nanushuk Gp	2841	69.35911	151.86160
14	50287100190000	KUPARUK	1A	BP	11/19/1964	12/05/1964	Schrader Bluff	758	69.29720	150.82970
15	50287100090000	UMIAT	9	U S NAVY	06/25/1951	01/15/1952	Nanushuk Gp	1257	69.38639	152.16690
16	50287100100000	UMIAT	10	U S NAVY	09/09/1951	01/10/1952	Grandstand Fm	1573	69.40028	152.12890
17	50119100120000	KNIFEBLADE	1	U S NAVY	10/13/1951	12/22/1951	Grandstand Fm	1805	69.15111	154.72250
18	50119100140000	KNIFEBLADE	2A	U S NAVY	08/06/1951	10/07/1951	Grandstand Fm	1805	69.13861	154.73670
19	50287100050000	UMIAT	5	U S NAVY	07/05/1950	10/04/1951	Nanushuk Gp	1077	69.38361	152.07970
20	50287100080000	UMIAT	8	U S NAVY	05/02/1951	08/28/1951	Grandstand Fm	1327	69.39861	152.11280
21	50119100130000	KNIFEBLADE	2	U S NAVY	07/26/1951	08/05/1951	Grandstand Fm	373	69.13861	154.73670
22	50119100090000	WOLF CREEK	2	U S NAVY	06/06/1951	07/01/1951	Grandstand Fm	1618	69.70472	153.52080
23	50119100080000	WOLF CREEK	1	U S NAVY	04/29/1951	06/04/1951	Grandstand Fm	1500	69.38639	153.52080
24	50287100070000	UMIAT	7	U S NAVY	12/14/1950	04/12/1951	Ninuluk Fm	1384	69.37473	152.10140
25	50279100300000	SIMPSON	31	U S NAVY	03/21/1951	04/02/1951	Nanushuk Gp	355	70.95556	154.62890
26	50279100250000	SIMPSON	27	U S NAVY	02/08/1951	03/14/1951	Nanushuk Gp	1500	70.93528	154.66780
27	50279100290000	SIMPSON	30A	U S NAVY	01/23/1951	02/06/1951	Nanushuk Gp	701	70.93027	154.68080
28	50279100280000	SIMPSON	30	U S NAVY	11/30/1950	01/23/1951	Nanushuk Gp	693	70.93083	154.67640
29	50287100060000	UMIAT	6	U S NAVY	08/14/1950	12/12/1950	Grandstand Fm	825	69.37778	152.09170
30	50279100270000	SIMPSON	29	U S NAVY	10/31/1950	11/26/1950	Nanushuk Gp	700	70.92973	154.69190
31	50279100240000	SIMPSON	26	U S NAVY	08/13/1950	10/23/1950	Nanushuk Gp	1171	70.93555	154.68440
32	50279100260000	SIMPSON	28	U S NAVY	09/05/1950	09/24/1950	Nanushuk Gp	2505	70.99250	154.67110
33	50279100230000	SIMPSON	25	U S NAVY	07/03/1950	08/12/1950	Nanushuk Gp	1510	70.93611	154.70330
34	50287100040000	UMIAT	4	U S NAVY	05/26/1950	07/29/1950	Grandstand Fm	840	69.38778	152.07890
35	50279100310000	MINGA VEL.	1	U S NAVY	04/29/1950	05/09/1950	Nanushuk Gp	1233	70.98333	154.74330
36	50023100030000	SIMPSON	24	U S NAVY	11/22/1949	11/28/1949	Nanushuk Gp	901	71.02944	154.61690
37	50023100020000	SIMPSON	23	U S NAVY	11/08/1949	11/16/1949	Nanushuk Gp	1035	71.03445	154.63390
38	50279100220000	SIMPSON	22	U S NAVY	10/29/1949	11/05/1949	Colville Group	903	70.99223	154.60420
39	50023100010000	SIMPSON	21	U S NAVY	10/13/1949	10/27/1949	Nanushuk Gp	1502	71.00806	154.61500
40	50279100210000	SIMPSON	20	U S NAVY	10/05/1949	10/11/1949	Nanushuk Gp	1002	70.99694	154.58860
41	50279100200000	SIMPSON	19	U S NAVY	09/23/1949	09/29/1949	Colville Group	1061	70.98778	154.71580
42	50279100190000	SIMPSON	18	U S NAVY	09/10/1949	09/21/1949	Colville Group	1460	70.99389	154.67030
43	50279100180000	SIMPSON	17	U S NAVY	08/31/1949	09/08/1949	Nanushuk Gp	1100	70.98666	154.64250
44	50279100170000	SIMPSON	16	U S NAVY	08/24/1949	08/30/1949	Nanushuk Gp	800	70.98333	154.63110
45	50023100110000	S BARROW	3	U S NAVY	06/23/1949	08/26/1949	Shublik Fm	2900	71.16278	156.57890
46	50279100160000	SIMPSON	15	U S NAVY	08/16/1949	08/23/1949	Nanushuk Gp	900	70.98500	154.63580
47	50279100150000	SIMPSON	14A	U S NAVY	08/14/1949	08/15/1949	Colville Group	290	70.98666	154.62720
48	50279100140000	SIMPSON	14	U S NAVY	07/21/1949	08/12/1949	Nanushuk Gp	1270	70.98666	154.62670
49	50279100130000	SIMPSON	13	U S NAVY	06/09/1949	07/20/1949	Nanushuk Gp	1438	70.98278	154.64530
50	50119100040000	OUMALIK	12	U S NAVY	04/01/1949	04/01/1949	Grandstand Fm	300	69.83833	155.99000
51	50119100030000	OUMALIK	11	U S NAVY	03/09/1949	03/22/1949	Grandstand Fm	303	69.83833	155.99000
52	50119100020000	OUMALIK	1	U S NAVY	07/21/1947	07/29/1947	Nanushuk Gp	392	69.82917	155.69170
53	50119100010000	IKPIKPUK CORE	1	U S NAVY	07/09/1947	07/17/1947	Nanushuk Gp	178	69.82667	155.39920
54	50287100120000	SENTINEL H.	1	U S NAVY	01/26/1947	03/23/1947	Sagav/Colv Undf	1180	69.61584	151.45300
55	50163100010000	SKULL CLIFF	1	U S NAVY	02/02/1947	03/17/1947	Torok Fm	779	70.90000	157.60000
56	50287100030000	UMIAT TEST	3	U S NAVY	11/15/1946	12/26/1946	Grandstand Fm	572	69.38667	152.08470
57	50279100120000	SIMPSON	12	U S NAVY	08/27/1945	08/29/1945	Colville Group	460	70.97195	155.29170
58	50279100110000	SIMPSON	11	U S NAVY	08/17/1945	08/26/1945	Colville Group	580	70.98028	155.29220
59	50279100100000	SIMPSON	10	U S NAVY	08/08/1945	08/15/1945	Nanushuk Gp	500	70.96194	155.29220
60	50279100090000	SIMPSON	9	U S NAVY	08/04/1945	08/07/1945	Nanushuk Gp	320	70.95750	155.29190
61	50279100080000	SIMPSON	8	U S NAVY	07/27/1945	08/03/1945	Nanushuk Gp	580	70.94527	155.29390
62	50279100070000	SIMPSON	7	U S NAVY	07/15/1945	07/25/1945	Nanushuk Gp	532	70.93027	155.30250
63	50279100060000	SIMPSON	6	U S NAVY	07/12/1945	07/13/1945	Nanushuk Gp	149	70.93278	155.30920
64	50279100050000	SIMPSON	5	U S NAVY	07/11/1945	07/12/1945	Nanushuk Gp	130	70.93806	155.27920
65	50279100040000	SIMPSON	4	U S NAVY	07/08/1945	07/10/1945	Nanushuk Gp	151	70.92944	155.26440
66	50279100030000	SIMPSON	3	U S NAVY	07/03/1945	07/07/1945	Nanushuk Gp	368	70.92750	155.29170
67	50279100020000	SIMPSON	2	U S NAVY	06/30/1945	07/02/1945	Nanushuk Gp	226	70.92750	155.29170
68	50279100010000	SIMPSON	1	U S NAVY	06/25/1945	06/29/1945	Nanushuk Gp	116	70.92834	155.28940

Appendix D

The issue of the southeastern boundary of the NPRA

Because the original legal description creating the NPRA was vague, different interpretations of the NPRA boundary existed prior to 1991. Most maps of the NPRA currently distributed by the USGS show Husky Lisburne No. 1 location well within the southeastern boundary. Based on a recent court settlement, however, a new survey was done in 1991 and the southeastern NPRA boundary was shifted to the west so that Lisburne No. 1 is now situated outside of the NPRA.

The original withdrawal of lands that established the Naval Petroleum Reserve was U.S. Executive Order (E.O.) 3793-A dated February 27, 1923, and signed by President Warren G. Harding. In E.O. 3793-A the southeast corner is defined as being near "the most northerly fork of the two easterly forks of Midas Creek, approximately latitude 67° 50', longitude 156° 08'".

After high quality topographic mapping was completed in northern Alaska there seemed to be a conflict between the location of the landmarks and the latitude-longitude location in the definition of the southeast corner of the NPRA. After the question arose as to which drainage was described in the vague description quoted above, the U.S. Government interpreted the southeast corner to be located at 67°57'59.9577" North latitude and 155°37'17.2738" West longitude. This interpretation of the NPRA boundary was disputed and later became the subject of a lawsuit brought by the State of Alaska, Arctic Slope Regional Corporation, and SOHIO Petroleum. The lawsuit resulted in the corner being subsequently redefined and resurveyed by the Bureau of Land Management. The final surveyed location agreed upon by the court for the southeast corner of the NPRA is identified in official survey notes, dated August 23, 1991, as 68° 04' 04.57" North latitude and 155° 59' 56.40" West longitude.

Lisburne No. 1 was originally drilled inside of the NPRA based on the U.S. Government's interpretation of the boundary at the time. The current NPRA boundary, adjudicated and resurveyed in 1991, places the well outside of the NPRA boundary.